



WARNING

DO NOT USE THIS MANUAL OR ANY OF THE RELATED MATERIALS IN ANY WAY IN THE OPERATION, USE OR MAINTENANCE OF ANY AIRCRAFT. THESE MATERIALS HAVE BEEN PREPARED AND ARE PROVIDED SOLELY TO GIVE GUIDANCE ON THE LAYOUT AND STRUCTURE OF A TYPICAL AIRCRAFT MANUAL. THESE MATERIALS HAVE NOT BEEN APPROVED BY ANY AVIATION ADMINISTRATION FOR USE ON ANY AIRCRAFT AND SHOULD NEVER BE SO USED UNDER ANY CIRCUMSTANCES. FAILURE TO FOLLOW THIS WARNING COULD LEAD TO SERIOUS INJURY OR DEATH.

777-200/-200LR/-300/-300ER
/F

Flight Crew Operations Manual The Boeing Company

Copyright © 1994
The Boeing Company
All Rights Reserved

Document Number D632W001-TBC
April 01, 1994

Revision Number: 46
Revision Date: June 14, 2010



Copyright Information

Boeing claims copyright in each page of this document only to the extent that the page contains copyrightable subject matter. Boeing also claims copyright in this document as a compilation and/or collective work.

The right to reproduce, distribute, display, and make derivative works from this document, or any portion thereof, requires a license from Boeing. For more information, contact The Boeing Company, P.O. Box 3707, Seattle, Washington 98124.

Boeing, the Boeing signature, the Boeing symbol, 707, 717, 727, 737, 747, 757, 767, 777, 787, BBJ, DC-8, DC-9, DC-10, MD-10, MD-11, MD-80, MD-88, MD-90 and the Boeing livery are all trademarks owned by The Boeing Company. No trademark license (either expressed or implied) is granted in connection with this document unless provided in writing by Boeing.

PAPER manuals

This is a PARTIAL revision. Only revised pages and their associated backing pages are printed. Be careful not to discard unchanged pages from previous revisions, or bulletins you may have received while this revision was being printed and shipped.

DIGITAL data

For customers receiving digital data by way of CD or MyBoeingFleet, there are files of only revised pages and files of the complete manuals (volume 1, volume 2 and the QRH). During the assembly process, revision bars from previous revisions are removed from the pages of the complete manuals files. These pages are not reprinted and shipped with the paper manuals unless they contain new changes.

Intentionally
Blank

Preface**Chapter 0****Chapter Table of Contents****Section 0****Volume 1**

Title Page	0
Preface	0
Revision Notice	0.RevNotice
Introduction	0.2
Abbreviations	0.3
V1V2 Revision Record	0.4
V1V2 List of Effective Pages	0.5
Bulletin Record	0.6
Service Bulletins	0.7
Limitations	L
Normal Procedures	NP
Supplementary Procedures	SP
Performance Dispatch	PD
Performance Inflight	PI

Volume 2

Airplane General, Emergency Equipment, Doors, Windows	1
Air Systems	2
Anti-Ice, Rain	3
Automatic Flight	4
Communications	5
Electrical	6
Engines, APU	7
Fire Protection	8
Flight Controls	9
Flight Instruments, Displays	10
Flight Management, Navigation	11
Fuel	12
Hydraulics	13

Landing Gear	14
Warning Systems	15

General

The airplanes listed in the table below are covered in this manual. The numbers are used to distinguish data peculiar to one or more, but not all of the airplanes. Where data applies to all airplanes listed, no reference is made to individual airplane numbers.

The table permits flight crew correlation of configuration differences by Registry Number in alpha/numeric order within an operator's fleet for airplanes covered in this manual. Configuration data reflects the airplane as delivered configuration and is updated for service bulletin incorporations in conformance with the policy stated in the introduction section of this chapter.

Airplane number is supplied by the operator. Registry number is supplied by the national regulatory agency. Serial and tabulation numbers are supplied by Boeing.

Airplane Number	Registry Number	Serial Number	Tabulation Number
200	777-200	7200	WY200
200ER	777-200ER	7250	WY250
200LR	777-200LR	7260	WY260
200FT	777-200FTR	7270	WY270
300	777-300	7300	WY300
300ER	777-300ER	7350	WY350

Intentionally
Blank

Preface
Introduction**Chapter 0**
Section 2**General**

This Flight Crew Operations Manual (FCOM) has been prepared by Boeing Commercial Airplanes, Commercial Aviation Services organization. The purpose of this FCOM is to:

- provide the operating limitations, procedures, performance, and systems information the flight crew needs to safely and efficiently operate the 777 airplane during all anticipated airline operations
- serve as a comprehensive reference for use during transition training for the 777 airplane
- serve as a review guide for use in recurrent training and proficiency checks
- provide necessary operational data from the FAA approved Airplane Flight Manual (AFM) to ensure that legal requirements are satisfied
- establish standardized procedures and practices to enhance Boeing operational philosophy and policy.

This manual is prepared for the owner/operator named on the title page specifically for the airplanes listed in the "Model Identification" section. It contains operational procedures and information, which apply only to these airplanes. The manual covers the Boeing delivered configuration of these airplanes. Changes to the delivered configuration are incorporated when covered by contractual revision agreements between the owner/operator and The Boeing Company.

This manual is not suitable for use for any airplanes not listed in the "Model Identification" section. Further, it may not be suitable for airplanes that have been transferred to other owners/operators.

Owners/operators are solely responsible for ensuring the operational documentation they are using is complete and matches the current configuration of the listed airplanes. This includes the accuracy and validity of all information furnished by the owner/operator or any other party. Owners/operators receiving active revision service are responsible to ensure that any modifications to the listed airplanes are properly reflected in the operational procedures and information contained in this manual.

The manual is structured in a two-volume format with a Quick Reference Handbook (QRH). Volume 1 includes operational limitations, normal and supplementary procedures, and dispatch performance data. Volume 2 contains systems information. The QRH contains all checklists necessary for normal and non-normal procedures as well as in-flight performance data.

The manual is periodically revised to incorporate pertinent procedural and systems information. Items of a more critical nature will be incorporated in operational bulletins and distributed in a timely manner. In all cases, such revisions and changes must remain compatible with the approved AFM with which the operator must comply. In the event of conflict with the AFM, the AFM shall supersede.

This manual is written under the assumption that the user has had previous multi-engine jet aircraft experience and is familiar with basic jet airplane systems and basic pilot techniques common to airplanes of this type. Therefore, the manual does not contain basic flight information that is considered prerequisite training.

Any questions about the content or use of this manual can be directed to:

Boeing Commercial Airplanes
Commercial Aviation Services
Attention: 777 Manager, Flight Technical Data
P.O. Box 3707, M/C 20-89
Seattle, Washington 98124-2207 USA
email: flighttraining@boeing.com
Telephone: (206) 662-4000
Fax: (206) 662-4743

Organization

The FCOM is organized in the following manner.

Volume 1 –

- Preface – contains general information regarding the manual's purpose, structure, and content. It also contains lists of abbreviations, a record of revisions, bulletins, and a list of effective pages.
- Limitations and Normal Procedures chapters cover operational limitations and normal procedures. All operating procedures are based on a thorough analysis of crew activity required to operate the airplane, and reflect the latest knowledge and experience available.
- Supplementary Procedures chapter covers those procedures accomplished as required rather than routinely on each flight.
- Performance Dispatch chapter contains performance information necessary for self dispatch.
- Performance Inflight chapter contains performance information necessary for inflight use.

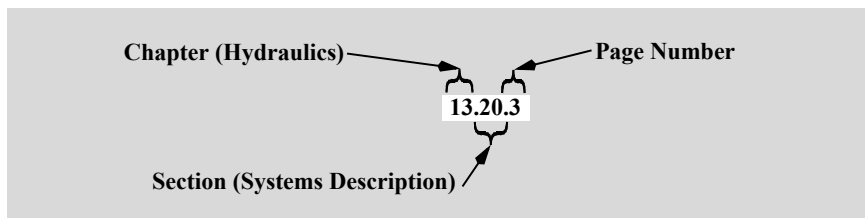
Volume 2 – Chapters 1 through 15 contain general airplane and systems information. These chapters are generally subdivided into sections covering controls and indicators and systems descriptions.

Quick Reference Handbook (QRH) – The QRH contains normal checklists, non-normal checklists, operational information, performance information necessary for inflight use on an expedited basis, and maneuvers.

Page Numbering

The FCOM uses a decimal page numbering system. The page number is divided into three fields; chapter, section, and page. An example of a page number for the hydraulics chapter follows: chapter 13, section 20, page 3.

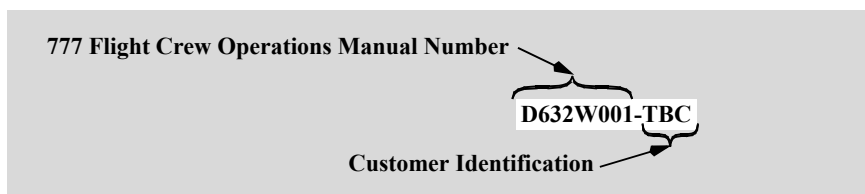
Example Page Number



Page Identification

Each page is identified by a customer document number and a page date. The customer document number is composed of the general 777 FCOM number, D632W001–, and is followed by the customer identification.

Example Page Identification



Warnings, Cautions, and Notes

The following levels of written advisories are used throughout the FCOM and are not to be confused with EICAS messages, which are separately identified in the text.

WARNING: An operating procedure, technique, etc., that may result in personal injury or loss of life if not carefully followed.

CAUTION: An operating procedure, technique, etc., that may result in damage to equipment if not carefully followed.

Note: An operating procedure, technique, etc., considered essential to emphasize. Information contained in notes may also be safety related.

Flight Crew Operations Manual Configuration

Customer airplane configuration determines the data provided in this manual. The Boeing Company keeps a list of each airplane configuration as it is built and modified through the Service Bulletin process. The FCOM does not reflect customer originated modifications without special contract provisions.

Options

[TBC only]

The following terms, enclosed in brackets, are used in this manual:

- [Airline Selectable Option] – this indicates a system feature basic to an airplane system that can be activated or deactivated by an airline.
- [Option] – this indicates a system or certification option. This term will not usually appear in an manual unless the customer configuration information is incomplete when the manual goes to print.

Airplane Effectivities

Differences in airplane configuration are shown by use of airplane effectivities throughout Volumes 1 and 2, and the Quick Reference Handbook. The following rules are used to express airplane effectivities:

- Airplane effectivities are listed in alpha-numeric order. A range of airplanes is defined by a dash, e.g. N-MA - N-PQ includes all "M" series airplanes and all "P" series aircraft through N-PQ. A comma in the effectivity range indicates a break in the range, e.g. N-FA - N-FC, N-FE - N-FG; airplane N-FD is excluded from the range.
- Airplane effectivities apply only to the paragraph, illustration, operational note, procedural step, etc. and to subordinate items (if any).

Example (with subordinate items):

N-AA - N-BB

CABIN CREW COMMUNICATIONS.....ESTABLISH

Evacuate lower crew rest compartment and close hatches.

Plan to land at the nearest suitable airport

In this example, the effectivity N-AA - N-BB applies to the first procedural step (CABIN CREW.....) and further indented/subordinate step (Evacuate....). The effectivity does not apply to the next equivalently indented step (Plan to land.....).

Example (without subordinate items):

N-XX - N-YY**NOTE:** Slats will extend beyond midrange when airspeed is below 246 knots. For go-around, do not exceed 246 knots until slats retract to midrange.**NOTE:** Use flaps 20 and VREF20 for landing.

In this example, the effectivity N-XX - N-YY applies to the first operational note only. The effectivity does not apply to the next equivalently indented note.

When airplane effectivities are centered immediately below a checklist title, the entire checklist applies to the listed airplanes. In the following example, the PACK L, R checklist is applicable to N-XX - N-YY only:



Intentionally
Blank

Preface
Abbreviations**Chapter 0**
Section 3**General**

The following abbreviations may be found throughout the manual. Some abbreviations may also appear in lowercase letters. Abbreviations having very limited use are explained in the chapter where they are used.

A	
ABV	Above
AC	Alternating Current
ACARS	Aircraft Communications Addressing and Reporting System
ACP	Audio Control Panel
ACT	Active
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADIRS	Air Data Inertial Reference System
ADIRU	Air Data Inertial Reference Unit
AFDS	Autopilot Flight Director System
AFM	Airplane Flight Manual (FAA approved)
A/G	Air/Ground
AGL	Above Ground Level
AIL	Aileron
ALT	Altitude
ALTN	Alternate

AM	Amplitude Modulation
AMI	Airline Modifiable Information
ANP	Actual Navigational Performance
ANT	Antenna
AOA	Angle of Attack
A/P	Autopilot
APL	Airplane
APP	Approach
APU	Auxiliary Power Unit
ARINC	Aeronautical Radio, Incorporated
ARPT	Airport
ARR	Arrival
ASA	Autoland Status Annunciator
ASYM	Asymmetry
A/T	Autothrottle
ATA	Actual Time of Arrival
ATC	Air Traffic Control
ATT	Attitude
AUTO-THROT	Autothrottle
AUTO	Automatic

AUX	Auxiliary
AVAIL	Available
B	
BARO	Barometric
BAT	Battery
B/CRS	Back Course
BFO	Beat Frequency Oscillator
BKR	Breaker
BLD	Bleed
BLW	Below
BRG	Bearing
BRT	Bright
BTL	Bottle
C	
C	Captain Celsius Center Cool
CANC	Cancel
CAP	Capture
CAPT	Captain
CB	Circuit Breaker
CDU	Control Display Unit
CG	Center of Gravity
CHR	Chronograph
CKT	Circuit
CL	Close
CLB	Climb
CLR	Clear
CMD	Command

CO	Company
COMM	Communication
COMP	Comparator
COMPT	Compartment
CON	Continuous
CONFIG	Configuration
CONT	Control
COOL	Cooling
CRS	Course
CRT	Cathode Ray Tube
CRZ	Cruise
CTL	Control
CTR	Center
D	
DA(H)	Decision Altitude (Height)
DC	Direct Current
DDG	Dispatch Deviations Guide
DEL	Delete
DEP	Departure
DEPR	Depressurize
DES	Descent
DH	Decision Height
DIFF	Differential
DISC	Disconnect
DISCH	Discharge
DK	Deck
DME	Distance Measuring Equipment
DN	Down

777 Flight Crew Operations Manual

DSPL	Display
E	
E/D	End of Descent
E/E	Electrical/Electronic
EEC	Electronic Engine Control
EFB	Electronic Flight Bag
EFI	Electronic Flight Instruments
EFIS	Electronic Flight Instrument System
EGT	Exhaust Gas Temperature
EICAS	Engine Indication and Crew Alerting System
ELEC	Electrical
ELEV	Elevator
EMER	Emergency
ENG	Engine
ENT	Entry
EO	Engine Out
EPR	Engine Pressure Ratio
EQPT or EQUIP	Equipment
ETOPS	Extended Range Operation with Twin Engine Airplanes
EVAC	Evacuation
EXEC	Execute
EXT	Extend or External
F	
F	Fahrenheit

FADEC	Full Authority Digital Engine Control
FCC	Flight Control Computer
FCOM	Flight Crew Operations Manual
FD, F/D or FLT DIR	Flight Director
FF	Fuel Flow
FDEVSS	Flight Deck Entry Video Surveillance System
FILT	Filter
FL CH or FLCH	Flight Level Change
FLT	Flight
FMA	Flight Mode Annunciations
FMC	Flight Management Computer
FMS	Flight Management System
F/O or F O	First Officer
FPA	Flight Path Angle
FPM	Feet Per Minute
FPV	Flight Path Vector
FREQ	Frequency
F/S	Fast/Slow
FT	Feet
FWD	Forward
FWSOV	Fire Wall Shut Off Valve
G	
GA	Go-Around
GEN	Generator
GMT	Greenwich Mean Time

GND	Ground
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
G/S	Glide Slope
GS	Ground Speed
H	
HDG	Heading
HF	High Frequency
HI	High
HLD	Hold
HPSOV	High Pressure Shut Off Valve
HSI	Horizontal Situation Indicator
HYD	Hydraulic
I	
IAS	Indicated Airspeed
IDENT	Identification
IGN	Ignition
IGS	Instrument Guidance System
IND LTS	Indicator Lights
INIT	Initialization
INSTR	Instrument
ILS	Instrument Landing System
INBD	Inboard
IND	Indicator
INOP	Inoperative
INT or INTPH	Interphone

INTC	Intercept
IRS	Inertial Reference System
ISA	International Standard Atmosphere
ISLN	Isolation
ISFD	Integrated Standby Flight Display
K	
K or KTS	Knots
KGS	Kilograms
L	
L	Left
LBS	Pounds
LD	Load
LDA	Localizer-type Directional Aid
LDG	Landing
LE	Leading Edge
LIM	Limit
LKD	Locked
L NAV or LNAV	Lateral Navigation
LOC	Localizer
LT	Light
M	
M	Mach
MAG	Magnetic
MAN	Manual
MAX	Maximum
MCP	Mode Control Panel

777 Flight Crew Operations Manual

MDA(H)	Minimum Descent Altitude (Height)
MEL	Minimum Equipment List
MFD	Multifunction Display
MIC	Microphone
MIN	Minimum
MLS	Microwave Landing System
MMO	Maximum Mach Operating Speed
MOD	Modify
MSG	Message
N	
N	Normal
NAV	Navigation
ND	Navigation Display
NM	Nautical Miles
NORM	Normal
NPS	Navigation Performance Scales
N1	Low Pressure Rotor Speed
N2	High Pressure Rotor Speed (Pratt & Whitney engines) Intermediate Pressure Rotor Speed (Rolls-Royce engines)
N3	High Pressure Rotor Speed (Rolls-Royce engines)
O	
OAT	Outside Air Temperature
OFST	Offset

OP	Open
OVHT	Overheat
OVRD	Override
OVSPD	Overspeed
OXY or O2	Oxygen
P	
PA	Passenger Address
PASS	Passenger
PCP	Pilot Call Panel
PERF	Performance
PES	Pitch Enhancement System
PF	Pilot Flying
PFD	Primary Flight Display
PM	Pilot Monitoring
PNL	Panel
POS	Position
PPOS	Present Position
PRES or PRESS	Pressure
PREV	Previous
P/RST	Push To Reset
PROX	Proximity
PRV	Pressure Regulating Valve
PSI	Pounds Per Square Inch
PTH	Path
PTT	Push To Talk
PTU	Power Transfer Unit
PWR	Power

PWS	Predictive Windshear System
Q	
Q	Quantity
QFE	Local Station Pressure
QNH	Local Station Pressure corrected to MSL
QTY	Quantity
R	
R	Right
RA	Radio Altitude Resolution Advisory
RAAS	Runway Awareness and Advisory System
RAD	Radio
RAT	Ram Air Turbine
RDMI	Radio Distance Magnetic Indicator
REC	Recorder
RECIR or RECIRC	Recirculation
REF	Reference
REV	Reverse
RF	Refill
RMI	Radio Magnetic Indicator
RNP	Required Navigational Performance
RNV	Area Navigation (RNAV)
RPM	Revolutions Per Minute
RST	Reset
RSVR	Reservoir
R/T	Radio Transmit

RTE	Route
RTO	Rejected Takeoff
RUD	Rudder
RVSM	Reduced Vertical Separation Minimum
S	
SAT	Static Air Temperature
SATCOM	Satellite Communication
SB	Service Bulletin
S/C	Step Climb
SEL	Select
SDF	Simplified Directional Facility
SELCAL	Selective Calling
SENS	Sensitivity
SERV	Service
SPD	Speed
SPDBRK	Speedbrake
STAB	Stabilizer
STBY	Standby
SYS	System
T	
T or TRU	True
T or TK or TRK	Track
TA	Traffic Advisory
TAI	Thermal Anti-Ice
TAT	Total Air Temperature
T/C	Top of Climb
TCAS	Traffic Alert and Collision Avoidance System

777 Flight Crew Operations Manual

T/D	Top of Descent
TE	Trailing Edge
TEMP	Temperature
TERR	Terrain
TFC	Traffic
TFR	Transfer
THR	Throttle Thrust
TO or T/O	Takeoff
TO/GA	Takeoff/Go-Around
TURB	Turbine Turbulence
U	
UNLKD	Unlocked
UNSCHD or UNSCHED	Unscheduled
USB	Upper Side Band
UTC	Universal Time Coordinated
UTIL	Utility
V	
VA	Design maneuvering Speed
VAL	Valve
VERT	Vertical
VHF	Very High Frequency
VIB	Vibration
VLV	Valve
VMO	Maximum Operating Speed
V NAV or VNAV	Vertical Navigation

VOR	VHF Omnidirectional Range
VR	Rotation Speed
VREF	Reference Speed
VSI	Vertical Speed Indicator
V/S	Vertical Speed
VTK	Vertical Track
V1	Takeoff Decision Speed
V2	Takeoff Safety Speed
W	
W	Warm
WHL	Wheel
WPT	Waypoint
WXR	Weather Radar
X	
X-FEED	Crossfeed
XPDR or XPNDR	Transponder
XTK	Cross Track

Intentionally
Blank

Preface**V1V2 Revision Record****Chapter 0****Section 4****Revision Transmittal Letter**

To: All holders of The Boeing Company 777 Flight Crew Operations Manual (FCOM), Boeing Document Number D632W001-TBC.

Subject: Flight Crew Operations Manual Revision.

This revision reflects the most current information available to The Boeing Company 45 days prior to the subject revision date.

General information below explains the use of revision bars to identify new or revised information. Highlights in the Revision Highlights section explain the revision bar changes in this revision.

Revision Record

No.	Revision Date	Date Filed
1	June 1, 1994	
3	October 17, 1994	
5	January 6, 1995	
7	April 10, 1995	
9	August 11, 1995	
11	November 28, 1995	
13	May 10, 1996	
15	November 7, 1996	
17	January 22, 1997	
19	August 18, 1997	
21	May 4, 1998	
23	December 18, 1998	
25	December 9, 1999	
27	December 11, 2000	
29	December 7, 2001	
31	December 16, 2002	

No.	Revision Date	Date Filed
2	September 1, 1994	
4	November 23, 1994	
6	February 10, 1995	
8	June 13, 1995	
10	September 15, 1995	
12	February 9, 1996	
14	August 12, 1996	
16	January 15, 1997	
18	March 11, 1997	
20	December 10, 1997	
22	August 10, 1998	
24	July 1, 1999	
26	June 26, 2000	
28	June 18, 2001	
30	June 17, 2002	
32	June 16, 2003	

No.	Revision Date	Date Filed
33	December 15, 2003	
35	December 13, 2004	
37	December 12, 2005	
39	December 11, 2006	
41	December 10, 2007	
43	December 15, 2008	
45	December 14, 2009	

No.	Revision Date	Date Filed
34	June 14, 2004	
36	June 13, 2005	
38	June 12, 2006	
40	June 11, 2007	
42	June 16, 2008	
44	June 15, 2009	
46	June 14, 2010	

General

The Boeing Company issues flight crew operations manual revisions to provide new or revised procedures and information. Formal revisions also incorporate appropriate information from previously issued flight crew operations manual bulletins.

The revision date is the approximate date the manual is mailed to the customer.

Formal revisions include a Transmittal Letter, a new Revision Record, Revision Highlights, and a current List of Effective Pages. Use the information on the new Revision Record and List of Effective Pages to verify the manual content.

Pages containing revised technical material have revision bars associated with the changed text or illustration. Highlights in the Revision Highlights section provide descriptions of the changes identified by the revision bars. Editorial revisions (for example, spelling corrections) may have revision bars with no associated highlight.

Filing Instructions

Consult the List of Effective Pages (0.5). Pages identified with an asterisk (*) are either replacement pages or new (original) issue pages. Remove corresponding old pages and replace or add new pages. Remove pages that are marked DELETED; there are no replacement pages for deleted pages.

Be careful when inserting changes not to throw away pages from the manual that are not replaced. Using the List of Effective Pages (0.5) can help determine the correct content of the manual.

After the revision has been filed into the manuals, the revision number, revision date and the date the revision was filed should be recorded in the Revision Record table above by the person that filed the revision.

Revision Highlights

This section (0.4) replaces the existing section 0.4 in your manual.

Throughout the manual, airplane effectivity may be updated to reflect coverage as listed on the Preface - Model Identification page, or to show service bulletin airplane effectivity. Highlights for these airplane effectivity updates are not supplied.

This manual is published from a database; the text and illustrations are marked with configuration information. Occasionally, because the editors rearrange the database markers, or mark items with configuration information due to the addition of new database content, some customers may receive revision bars on content that appears to be unchanged. Pages may also be republished without revision bars due to slight changes in the flow of the document.

Chapter 0 - Preface

Section 3 - Abbreviations

- 0.3.3 - Added EFB abbreviation.
- 0.3.3 - Added FDEVSS abbreviation.
- 0.3.5 - Added ND abbreviation
- 0.3.5 - Added PFD abbreviation
- 0.3.6 - Added RAAS abbreviation.
- 0.3.6 - Added SATCOM abbreviation

Section 6 - Bulletin Record

- 0.6.3-4 - Revised to reflect current bulletin status.

Chapter B - Bulletins

Section 101 - Covers

- B.101.2 - Added specific service bulletin information that will, when installed, fix the anomaly that caused this operations manual bulletin to be issued.

Section 105 - Covers

- B.105.2 - Revised SB number that updates AIMS-1 hardware with BP V14.

Section 107 - Covers

- B.107.2 - Revised SB number that updates AIMS-1 hardware with BP V14.

Section 108 - Covers

B.108.2 - Added specific service bulletin information that will, when installed, fix the anomaly that caused this operations manual bulletin to be issued.

Section 115 - Covers

B.115.1 - Revised to incorporate new operating instructions and to add specific service bulletin information that resolves the anomaly when incorporated.

Chapter L - Limitations

Section 10 - Operating Limitations

Operational Limitations

L.10.1 - Moved maximum demonstrated crosswind from non-AFM section to table to reflect it is in the AFM.

L.10.1 - Moved turbulent air penetration paragraph to reflect the limitation is in the AFM.

Chapter SP - Supplementary Procedures

Section 7 - Engines, APU

Manual Engine Start

SP.7.3-4 - Revised nomenclature for "maximum motoring" by deleting "speed" for consistency.

Chapter PD - Performance Dispatch

Section 10 - Table of Contents

PD.TOC.10.1 - 777-200 GE90-76B KG JAA was added as Section 10.

Section 10 - Takeoff

Takeoff

PD.10.1 - 777-200 GE90-76B KG JAA was added as Section 10.

Section 20 - Table of Contents

PD.TOC.20.1 - 777-200ER TRENT892 KG FAA was added as Section 20.

Section 23 - Gear Down**Holding Planning**

PD.23.8 - Revised data to take into account the higher VREF speeds at sea level. Previous data were calculated with a speed restriction based on VREF at 10000 ft.

Section 30 - Table of Contents

PD.TOC.30.1 - 777-200LR GE90-110B1L KG FAA was added as Section 30.

Section 40 - Table of Contents

PD.TOC.40.1 - 777F GE90-110B1L KG JAA was added as Section 40.

Section 44 - Text**Takeoff**

PD.44.1 - Added line-up allowance table.

Section 50 - Table of Contents

PD.TOC.50.1 - 777-300 PW4090 LB FAA was added as Section 50.

Section 60 - Table of Contents

PD.TOC.60.1 - 777-300ER GE90-115BL LB FAA was added as Section 60.

Chapter PI - Performance Inflight**Section 10 - Table of Contents**

PI.TOC.10.1 - 777-200 GE90-76B KG JAA was added as Section 10.

Section 10 - General**General**

PI.10.1 - 777-200 GE90-76B KG JAA was added as Section 10.

Section 20 - Table of Contents

PI.TOC.20.1 - 777-200ER TRENT892 KG FAA was added as Section 20.

Section 20 - General**VREF**

PI.20.2 - Updated VREF data to match the FMC data.

Section 21 - All Engine

Holding

PI.21.7 - Revised data to take into account the higher VREF speeds at sea level. Previous data were calculated with a speed restriction based on VREF at 10000 ft.

Section 22 - Advisory Information

Normal Configuration Landing Distance

PI.22.1-3 - Updated data to reflect the incorporation of engine out loss of control speeds (VLOC), higher reference landing weight, and additional autobrake settings.

Section 23 - Engine Inoperative

Holding

PI.23.10 - Revised data to take into account the higher VREF speeds at sea level. Previous data were calculated with a speed restriction based on VREF at 10000 ft.

Gear Down Landing Rate of Climb Available

PI.23.11 - Revised data to reflect a higher reference weight.

Section 26 - Gear Down

Holding

PI.26.6 - Revised data to take into account the higher VREF speeds at sea level. Previous data were calculated with a speed restriction based on VREF at 10000 ft.

Section 30 - General

VREF

PI.30.2 - Updated VREF data to match the FMC data.

Section 32 - Advisory Information

Normal Configuration Landing Distance

PI.32.1-4 - Updated data to reflect the incorporation of engine out loss of control speeds (VLOC), higher reference landing weight, and additional autobrake settings.

Non-Normal Configuration Landing Distance

PI.32.5-8 - Updated data to reflect the incorporation of engine out loss of control speeds (VLOC), higher reference landing weight, and additional autobrake settings.

Section 30 - Table of Contents

PI.TOC.30.1 - 777F GE90-110B1L KG JAA was added as Section 30.

Section 40 - General**VREF**

PI.40.2 - Updated VREF data to match the FMC data.

Section 42 - Advisory Information**Normal Configuration Landing Distance**

PI.42.1-3 - Updated data to reflect the incorporation of engine out loss of control speeds (VLOC), higher reference landing weight, and additional autobrake settings.

Non-Normal Configuration Landing Distance

PI.42.4-26 - Updated data to include autobrake performance and reflect a change in table format and reference weight.

PI.42.26 - Updated footnote table format

Section 40 - Table of Contents

PI.TOC.40.1 - 777-300 PW4090 LB FAA was added as Section 40.

Section 50 - General**VREF**

PI.50.2 - Updated VREF data to match the FMC data.

Section 50 - Table of Contents

PI.TOC.50.1 - 777-300ER GE90-115BL LB FAA was added as Section 50.

Section 60 - General**VREF**

PI.60.2 - Updated VREF data to match the FMC data.

Chapter 1 - Airplane General, Emergency Equipment, Doors, Windows**Section 21 - Inst. Panels, Overhead****Overhead Panel**

1.21.1 - Added chapter references to the APU selector, FUEL JETTISON panel, and Cockpit Voice Recorder microphone to reflect where the descriptions are located. Added ELT, HUMID, and GASPER switches to reflect optional systems.

1.21.2 - Replaced the FWD CARGO A/C switch with the LWR CARGO TEMP controller to reflect optional system. Added chapter references to the APU selector, FUEL JETTISON panel, and Cockpit Voice Recorder microphone to reflect where the descriptions are located.

Overhead Maintenance Panel

1.21.3 - Removed LWR AFT CARGO TEMP controller to reflect the switch is not located on the overhead maintenance panel.

Section 22 - Inst. Panels, Fwd

Forward Aisle Stand

1.22.6 - Revised forward aisle stand graphic to reflect look-ahead terrain alerting installed.

Section 23 - Inst. Panels, Aft and Side

Control Stand

1.23.1 - Added chapter references for the Takeoff/Go-around, Autothrottle disconnect, and FUEL CONTROL switches to reflect where the descriptions are located.

Aft Aisle Stand

1.23.2-3 - Added chapter reference to the TCAS/Transponder panel to reflect the TCAS and Transponder controls are described in separate chapters.

Section 30 - Controls and Indicators

Alternate Action Switches

1.30.1 - Revised momentary action switch description for cross-model standardization.

Signs and Lighting

1.30.3 - Changed "airplane altitude" to "cabin altitude" to reflect cabin altitude is used for the automatic illumination of the NO SMOKING sign.

Main Deck Cargo Lighting Control

1.30.11 - Added "Main Deck Cargo Door" prior to switch nomenclature to clarify what MDCD is an abbreviation for.

Supernumerary Oxygen Switch

1.30.29 - Changed capitalization of Supernumerary and added switch nomenclature for standardization.

Section 40 - Systems Description**Passenger Oxygen System**

1.40.12 - Added approximate length of time oxygen will be supplied by the oxygen generators to insure the flight crew is aware of how long the passengers and flight attendants will be supplied oxygen.

Section 45 - Emergency Equipment**Fire Extinguishers**

1.45.3 - Added information covering location of halon fire extinguishers on the freighter airplane.

Section 47 - Overhead Crew Rest**Entrance Enclosure**

1.47.7 - No technical change; grammatical correction only.

1.47.7 - Added note to reflect current system operation: in airplanes with both door 1 and door 5 upper crew rest areas, the AIRFLOW / SMOKE RESET switch in both entrance enclosures must be pushed to ensure proper restoration of aft galley power.

1.47.7 - Revised note to reflect current system operation.

Decompression

1.47.15 - Title revised for clarification.

1.47.15 - No technical change; format only.

1.47.32 - Title revised for clarification.

1.47.32 - No technical change; format only.

Entrance Enclosure

1.47.43 - Added note to reflect current system operation: in airplanes with both door 1 and door 5 upper crew rest areas, the AIRFLOW / SMOKE RESET switch in both entrance enclosures must be pushed to ensure proper restoration of aft galley power.

1.47.43 - Revised note to reflect current system operation.

Decompression

1.47.49 - Title revised for clarification.

Section 48 - Lower Crew Rest**Introduction**

1.48.1 - Corrected nomenclature: replaced overhead crew rest areas with lower crew rest area.

Section 50 - Doors, Windows, Seats

Overwing Escape Slide

- 1.50.6 - Changed the door 3 ditching caution to a warning to emphasize the importance of not using the ramp/slide.

Chapter 2 - Air Systems

Section 10 - Controls and Indicators

Lower Cargo Temperature Control

- 2.10.11 - Added freighter configuration.

Section 20 - Air Conditioning System Description

Introduction

- 2.20.1 - Added freighter configuration.
- 2.20.1 - Deleted freighter configuration.

Section 30 - Pressurization System Description

Pressurization System Manual Operation

- 2.30.2 - Corrected OUTFLOW VALVE text.

Chapter 4 - Automatic Flight

Section 10 - Controls and Indicators

Autopilot Flight Director IAS/Mach Controls

- 4.10.5 - Deleted bullet; information pertains to IAS/MACH window

Autopilot Flight Director Roll and Pitch Controls

- 4.10.8 - Revised for clarity. Added information about FLCH climb/descent.

Autopilot Flight Director Vertical Speed (V/S) and Flight Path Angle (FPA) Controls

- 4.10.11 - Added information for clarity.

TO/GA and Autothrottle Disconnect Switches

- 4.10.19 - Revised for consistency with 4.20.

Section 20 - System Description

AFDS Flight Mode Annunciations

- 4.20.7 - Added sentence for clarity.
- 4.20.7 - Revised for clarity and consistency with the 747-400 description.

Automatic Flight Takeoff and Climb

4.20.11 - Added climb derates and assumed temperature thrust reduction.

Chapter 5 - Communications**Section 10 - Controls and Indicators****Audio Control Panel**

5.10.1 - Revised title by deleting "(ACP)" for consistency. ACP is defined in Chapter 0, Section 3 (Abbreviations).

5.10.3 - Deleted information to reflect ADF installed.

Radio Tuning Panel

5.10.5 - Revised paragraph by deleting "(amplitude modulation)" and "(upper side band)" for consistency. AM and USB are defined in Chapter 0, Section 3 (Abbreviations).

Observer Audio Selector

5.10.13 - Revised text by replacing "Captain (CAPT)" with "CAPT" for consistency. CAPT is defined in Chapter 0, Section 3 (Abbreviations).

5.10.13 - Revised text by replacing "Normal (NORM)" with "NORM" for consistency. NORM is defined in Chapter 0, Section 3 (Abbreviations).

5.10.13 - Revised text by replacing "First Officer (F/O)" with "F/O" for consistency. F/O is defined in Chapter 0, Section 3 (Abbreviations).

Section 20 - System Description**Introduction**

5.20.1 - Revised text by replacing "control display unit (CDU)" with "CDU" for consistency. CDU is defined in Chapter 0, Section 3 (Abbreviations).

5.20.1 - Revised text by replacing "multifunction display (MFD)" with "MFD" for consistency. MFD is defined in Chapter 0, Section 3 (Abbreviations).

Audio Control Panels

5.20.1 - Revised text by deleting "(microphone)" for consistency. MIC is defined in Chapter 0, Section 3 (Abbreviations).

Cockpit Voice Recorder System

5.20.2 - Revised CVR description for clarity by adding text to reflect it also records flight deck area conversations using "crewmember boom, oxygen mask, and hand microphones, independent of microphone/interphone switch positions."

Radio Communication Systems

5.20.2 - Revised paragraph by replacing "very high frequency (VHF)," "high frequency (HF)," "satellite communication (SATCOM)," and "selective calling (SELCAL)" with VHF, HF, SATCOM, and SELCAL, respectively. Abbreviations are defined in Chapter 0, Section 3.

VHF Communication System

5.20.2 - Revised sentence by deleting "(left)," "(center)," and "(right)" for consistency. L, C, and R are defined in Chapter 0, Section 3 (Abbreviations).

HF Communication System

5.20.3 - Revised sentence by deleting "(left)" and "(right)" for consistency. L and R are defined in Chapter 0, Section 3 (Abbreviations).

SELCAL System

5.20.4 - Revised title by replacing "Selective Calling (SELCAL)" with "SELCAL" for consistency. SELCAL is defined in Chapter 0, Section 3 (Abbreviations).

SATCOM System

5.20.4 - Revised title by replacing "Satellite Communication (SATCOM)" with "SATCOM" for consistency. SATCOM is defined in Chapter 0, Section 3 (Abbreviations).

SATCOM Phone Pages [Typical]

5.20.6 - Revised graphic by moving CHAN STATUS selection from line select key 6L to 5L.

Section 30 - Interphone Systems

Passenger Address System

5.30.2 - Revised sentence by replacing "passenger address (PA)" with PA for consistency. PA is defined in Chapter 0, Section 3 (Abbreviations).

Personnel Address System

5.30.2 - Revised sentence by replacing "personnel address (PA)" with PA for consistency. PA is defined in Chapter 0, Section 3 (Abbreviations).

Cabin Interphone System

5.30.3 - Revised sentence for consistency; deleted text "(cabin)" when specifying CAB transmitter select switch.

5.30.9 - Revised sentence for consistency; deleted text "(cabin)" when specifying CAB transmitter select switch.

5.30.9 - Corrected typo; changed text "eliminated" to "eliminate."

Section 40 - MFD Communications Functions**Introduction**

5.40.1 - Revised sentence wording for consistency; replaced "communication (COMM)" and "multifunction display (MFD)" with COMM and MFD, respectively. COMM and MFD are defined in Chapter 0, Section 3 (Abbreviations).

Communications Menus

5.40.3 - Added description of ATC downlink with ARINC 623 data link messages activated and AIMS V14 or later software not installed.

5.40.3 - Deleted description of ATC downlink with ARINC 623 data link messages activated and AIMS V14 software installed.

Route Request

5.40.23 - Revised text by replacing "L (left)" and "R (right)" with "L" and "R" for consistency. L and R are defined in Chapter 0, Section 3 (Abbreviations).

ATC Logon/Status

5.40.30 - Revised sentence by adding "(registry number)" after "tail number" to clarify they are the same number.

Position Report

5.40.36 - Deleted note describing Position Report page anomaly; anomaly is corrected by installation of AIMS 2003 or later software.

Flight Information Menu

5.40.39 - Added illustration to reflect flight information menu with AIMS 2001 or later software installed.

5.40.39 - Deleted graphic of flight information menu with AIMS V14 or later software installed.

ATIS Request

5.40.44 - Deleted illustration and description that reflected flight information menu enabled with AIMS V14 or later software installed.

Automatic Dependent Surveillance Manager

5.40.54 - Revised paragraph by replacing "automatic dependant surveillance (ADS)" with ADS for consistency. ADS is defined in Chapter 0, Section 3 (Abbreviations).

System Information Manager

5.40.54 - Revised the System Information Manager section by adding display and description of TAIL NUMBER and AIRLINE entry fields.

5.40.55 - Added description of AIRLINE entry field on System Information manager page that reflects AIMS V14 or later software installed.

Chapter 7 - Engines, APU

Section 10 - Controls and Indicators

Fuel Control Switches

7.10.27 - Corrected spelling of "ignitors" by deleting "(s)."

Engine Control Panel

7.10.30 - Revised CON description for consistency; added text to reflect igniters operate continuously "in flight, or on the ground with flaps set for takeoff above 60% N1."

Section 20 - Engine System Description

Introduction

7.20.1 - Corrected engine model number by adding an "L" at the end; engine model now reads GE90-110B1L.

7.20.1 - Revised text by replacing "electronic engine controller (EEC)" with "EEC" for consistency. EEC is defined in Chapter 0, Section 3 (Abbreviations).

7.20.1 - Revised text by replacing "engine indication and crew alerting system (EICAS)" with "EICAS" for consistency. EICAS is defined in Chapter 0, Section 3 (Abbreviations).

Engine Indications

7.20.2 - Revised text by replacing "multifunction display (MFD)" with "MFD" for consistency. MFD is defined in Chapter 0, Section 3 (Abbreviations).

EEC Alternate Mode

7.20.8 - Revised text by replacing "alternate (ALTN)" with "ALTN" for consistency. ALTN is defined in Chapter 0, Section 3 (Abbreviations).

Autostart

7.20.11 - Corrected typo by removing extra space after "fuel." Revised spelling of "ignitors" for consistency.

7.20.12-13 - Revised spelling of "ignitor" for consistency.

7.20.13 - Revised spelling of "ignitors" for consistency. Corrected typo by removing extra space after "re-introducing."

7.20.14 - Revised spelling of "ignitors" for consistency.

Engine Ignition

7.20.16 - Revised text for consistency with no change to technical content; moved phrase "continuous ignition is selected" to end of sentence.

Engine Oil System

7.20.22 - Corrected typo; added a space at end of the sentence.

Chapter 8 - Fire Protection**Section 10 - Controls and Indicators****APU and Cargo Fire Panel**

8.10.7 - Revised depressurization altitude from 25,000 feet to 23,000 feet to reflect current airplane system operation.

Section 20 - System Description**Main Deck Cargo Compartment Fire Suppression**

8.20.7 - Revised depressurization altitude from 25,000 feet to 23,000 feet to reflect current airplane system operation.

Chapter 10 - Flight Instruments, Displays**Section 10 - Controls and Indicators****PFD Indications**

10.10.2 - Moved "Air Data Inertial Reference System (ADIRS)" so the acronym definition is prior to the first use of the acronym. Capitalized Air Data Inertial Reference System to reflect it is the name of a system.

10.10.2 - Removed "Air Data Inertial Reference Systems"; the acronym is previously defined.

PFD Reference Speeds

10.10.5 - Changed the selected landing flap and VREF speed display to green to reflect the correct display color.

PFD Attitude Indications

10.10.10 - Changed "up" to "retracted" for standardization of flap position nomenclature; no technical change.

PFD Navigation Performance Indications

10.10.14 - Added a space in between "LNAV/" and "G/S" to reflect there is a space after the slash on the display.

ND Navigation Performance Indications

10.10.30 - Changed "VOR 2" to "VOR R" to accurately reflect the VOR selection display does not change when Navigation Performance Indications are displayed.

Section 30 - Primary Flight Displays (PFDs)

Airspeed

10.30.1 - Changed "maneuver" to "maneuvering" for consistency; no technical change.

Typical PFD Displays

10.30.14 - Deleted PFD approach display illustration to reflect selected landing flaps and VREF display option installed.

10.30.14 - Added PFD approach display illustration to reflect selected landing flaps and VREF display option installed.

10.30.15 - Deleted PFD approach display illustration to reflect selected landing flaps with VREF display option installed.

10.30.15 - Added PFD approach display illustration to reflect selected landing flaps with VREF display option installed.

10.30.17 - Deleted PFD landing display illustration to reflect selected landing flaps with VREF display option installed.

10.30.17 - Added PFD landing display illustration to reflect selected landing flaps with VREF display option installed.

10.30.18 - Deleted PFD landing display illustration to reflect airplane configuration.

10.30.18 - Added PFD landing display illustration to reflect airplane configuration.

Section 40 - Navigation Displays

Typical ND Map Displays

10.40.3 - Added weather range arcs to expanded ND graphic with WXR selected for accuracy.

10.40.4 - Added range arcs to the expanded ND graphic with WXR selected for accuracy.

ND Symbolology

10.40.11 - Added track line with range arcs symbol to reflect range arcs are installed.

10.40.23 - Added Runway Awareness and Advisory System alert symbols to reflect Runway Advisory and Alert System installed.

10.40.23 - Added ON TAXIWAY caution alert symbol to reflect the Runway Awareness and Advisory System with ON TAXIWAY alert installed.

Chapter 11 - Flight Management, Navigation

Section 31 - Flight Management System Operation

Maintenance Index

11.31.5 - Deleted Airline Policy subparagraph; moved information to callout.

Waypoints

11.31.14 - Moved sentence from "Procedure Arc Fix Waypoint Names"; information is not consistent with arc procedures.

Vertical Navigation (VNAV)

11.31.17 - Added information for clarity.

Vertical Actual Navigation Performance (VANP)

11.31.17 - Added paragraph describing VANP.

Section 34 - Company Data Link

Data Link

11.34.3 - Revised for clarity.

CDU Data Link Status Displays

11.34.10 - Revised; moved data to lines 3 and 4; deleted prompts on NO COMM - not selectable.

Section 40 - FMC Preflight

Position Reference Page 2/3

11.40.12 - "LOC-GPS" can no longer display with AIMS V14 FMC software.

Route Page 1/X

11.40.18 - Revised RTE page descriptions for clarity.

11.40.20 - Revised for clarity.

Departures Page

11.40.26 - Revised for clarity.

Performance Initialization Page

11.40.37 - Added paragraph for AMI selectable default cruise CG with AIMS V14 software.

Takeoff Reference Page 1/2

11.40.45 - Added information about the FMC Takeoff Speed Relative Value check.

11.40.45 - Information about V speed entry added.

Chapter 12 - Fuel

Section 10 - Controls and Indicators

Fuel Jettison System

12.10.4 - Moved definition of abbreviation "MLW" from callout 5 to preceding callout 3 for clarity.

12.10.4 - Corrected typo by adding space after "ON," and deleted "(maximum landing weight)" and "(manual)" for consistency. MLW is defined in callout 3 description and MAN is defined in Chapter 0, Section 3 (Abbreviations).

12.10.4 - Revised text by replacing "CW/CCW" with "clockwise/counterclockwise," and "MANUAL" with "MAN" for consistency.

12.10.4 - Revised text by replacing "manual (MAN)" with "MAN" for consistency.

Fuel Jettison Indications

12.10.10 - Revised paragraph for consistency; replaced "fuel jettison ARMED" with "MLW displayed."

12.10.10 - Revised description for consistency; moved "fuel jettison ARMED" from leading paragraph to first bulleted item in string.

12.10.10 - Revised text for consistency; deleted "(MLW)."

12.10.10 - Revised paragraph for consistency; replaced "MAN (manual) selection is displayed" with "(MAN displayed)."

Fuel Synoptic Indications

12.10.19 - Corrected Minimum Fuel Temperature description by replacing second sentence with the following: "Refer to Chapter 11, Flight Management, Navigation, Section 40, for a description....".

12.10.19 - Revised Fuel Temperature description for clarity by adding the following: "Displays the left main tank fuel temperature."

Section 20 - System Description

Fuel Jettison

12.20.17 - Revised text by replacing "maximum landing weight (MLW)" with "MLW" for consistency. MLW is defined previously in chapter 12.

Chapter 13 - Hydraulics**Section 10 - Controls and Indicators**

Hydraulic Panel

- 13.10.1 - Added "RAT" to clarify the abbreviation for the Ram Air Turbine.

Chapter 14 - Landing Gear**Section 20 - System Description**

Introduction

- 14.20.1 - Revised "alternate/reserve brake" to "alternate brake" to clarify there are only two brake systems. Added "reserve" to the hydraulic system source for the alternate brake system to reflect there is a reserve source of hydraulic fluid.

Brake System

- 14.20.4 - Removed "/reserve" to clarify there are only two brake systems.

Alternate Brake Hydraulic System

- 14.20.4 - Removed "/reserve" to clarify there are only two brake systems.

Antiskid Protection

- 14.20.4-5 - Removed "/reserve" to clarify there are only two brake systems.

Chapter 15 - Warning Systems**Section 10 - Controls and Indicators**

GPWS Look-Ahead Terrain Alerting Display and Annunciations

- 15.10.19 - Added Note previously omitted.

Section 20 - System Description

Runway Awareness and Advisory System (RAAS)

- 15.20.22 - RAAS installed.

GPWS Non-Normal Operation

- 15.20.29 - RAAS installed.

Voice Annunciation Inhibits

- 15.20.30 - RAAS installed.

Section 30 - EICAS Messages

Warning Systems EICAS Alert Messages

- 15.30.2 - RAAS installed.

Intentionally
Blank

Preface**Chapter 0****V1V2 List of Effective Pages****Section 5**

Page	Date
Volume 1	
* Title Page	June 14, 2010
* Copyright	June 14, 2010
* 0.RevNotice.1-2	June 14, 2010
0.TOC.0.1-2	June 15, 2009
Model Identification	
* 0.1.1-2	June 14, 2010
0.2.1	June 16, 2008
0.2.2-3	December 14, 2009
0.2.4-6	June 16, 2008
0.3.1	June 16, 2008
* 0.3.2-7	June 14, 2010
0.3.8	June 16, 2008
Revision Record (tab)	
* 0.4.1-20	June 14, 2010
List of Effective Pages	
* 0.5.1-14	June 14, 2010
Bulletins (tab)	
* 0.6.1-6	June 14, 2010
B.28.1-2	December 15, 2008
B.50.1-2	December 15, 2008
B.52.1-2	December 15, 2008
B.55.1-4	December 15, 2008
B.56.1-2	December 15, 2008
B.58.1-2	December 15, 2008
B.62.1-2	December 15, 2008
B.63.1-2	December 15, 2008

Page	Date
Bulletins (cont)	
B.64.1-2	December 15, 2008
B.65.1-2	December 15, 2008
B.66.1-2	December 15, 2008
B.68.1-2	December 15, 2008
B.72.1-2	December 15, 2008
B.73.1	June 15, 2009
B.73.2-3	December 15, 2008
B.73.4-7	June 15, 2009
B.73.8	December 15, 2008
B.75.1-2	December 15, 2008
B.76.1-2	December 15, 2008
B.77.1-2	December 15, 2008
B.78.1-2	December 15, 2008
B.79.1-2	December 15, 2008
B.80.1-2	December 15, 2008
B.81.1-4	December 15, 2008
B.82.1-4	December 15, 2008
B.83.1-6	December 15, 2008
B.85.1-2	December 15, 2008
B.87.1-2	December 15, 2008
B.88.1-2	December 15, 2008
B.90.1-2	December 15, 2008
B.91.1-4	December 15, 2008
B.92.1-2	December 15, 2008
B.93.1-2	December 15, 2008
B.95.1-4	December 15, 2008
B.96.1-4	December 15, 2008
B.97.1-2	December 15, 2008

* = Revised, Added, or Deleted

Copyright © The Boeing Company. See title page for details.

777 Flight Crew Operations Manual

Page	Date	Page	Date
Bulletins (cont)		Normal Procedures (cont)	
B.99.1-2	December 15, 2008	NP.21.5	June 11, 2007
B.100.1-4	December 15, 2008	NP.21.6-8	June 12, 2006
* B.101.1-2	June 14, 2010	NP.21.9-10	December 10, 2007
B.102.1-4	December 15, 2008	NP.21.11-12	June 12, 2006
B.103.1-2	December 15, 2008	NP.21.13-15	December 14, 2009
B.104.1-2	December 15, 2008	NP.21.16-27	June 16, 2008
* B.105.1-2	June 14, 2010	NP.21.28	December 10, 2007
B.107.1	June 15, 2009	NP.21.29-34	June 16, 2008
* B.107.2	June 14, 2010	NP.21.35-38	December 14, 2009
* B.108.1-2	June 14, 2010	NP.21.39	December 15, 2008
B.111.1-3	June 15, 2009	NP.21.40	December 14, 2009
B.111.4	December 14, 2009	NP.21.41-43	June 15, 2009
B.114.1-2	December 14, 2009	NP.21.44	December 14, 2009
* B.115.1-2	June 14, 2010	NP.21.45	June 15, 2009
* B.116.1-2	June 14, 2010	NP.21.46	December 14, 2009
* B.117.1-4	June 14, 2010	NP.21.47	June 15, 2009
0.7.1	December 14, 2009	NP.21.48-53	December 14, 2009
0.7.2	June 16, 2008	NP.21.54	June 15, 2009
Limitations (tab)		NP.21.55	December 14, 2009
* L.TOC.0.1-2	June 14, 2010	NP.21.56	June 15, 2009
* L.10.1-8	June 14, 2010	Supplementary Procedures (tab)	
Normal Procedures (tab)		* SP.TOC.0.1-4	June 14, 2010
NP.TOC.0.1-2	June 15, 2009	SP.05.1	December 15, 2008
NP.11.1-4	December 15, 2008	SP.05.2	June 12, 2006
NP.11.5	December 10, 2007	SP.1.1	December 14, 2009
NP.11.6	June 12, 2006	SP.1.2	December 10, 2007
NP.11.7	December 14, 2009	SP.2.1	December 14, 2009
NP.11.8	June 12, 2006	SP.2.2-4	December 15, 2008
NP.21.1-3	June 12, 2006	SP.3.1-2	June 12, 2006
NP.21.4	December 10, 2007	SP.4.1	December 11, 2006

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
Supplementary Procedures (cont)		Performance - Dispatch (tab)	
SP.4.2-3	June 26, 2000	* PD.TOC.1-2	June 14, 2010
SP.4.4	June 11, 2007	* PD.TOC.10.1-2	June 14, 2010
SP.4.5-6	December 11, 2006	* PD.10.1-10	June 14, 2010
SP.5.1-2	December 16, 2002	* PD.11.1-12	June 14, 2010
SP.6.1	June 26, 2000	* PD.12.1-4	June 14, 2010
SP.6.2	June 16, 2003	* PD.13.1-8	June 14, 2010
SP.7.1-2	December 14, 2009	* PD.14.1-8	June 14, 2010
* SP.7.3-6	June 14, 2010	* PD.TOC.20.1-2	June 14, 2010
SP.10.1	June 15, 2009	PD.20.1	December 7, 2001
SP.10.2	December 11, 2000	PD.20.2-10	December 14, 2009
SP.11.1-8	December 14, 2009	PD.21.1-5	December 7, 2001
SP.12.1	June 15, 2009	PD.21.6	December 16, 2002
SP.12.2	June 17, 2002	PD.21.7	June 13, 2005
SP.15.1-2	December 14, 2009	PD.21.8	December 16, 2002
SP.16.1	June 15, 2009	PD.21.9-11	December 15, 2008
SP.16.2	December 14, 2009	PD.21.12	December 10, 2007
SP.16.3	June 11, 2007	PD.22.1-2	June 14, 2004
SP.16.4	December 15, 2008	PD.22.3	December 14, 2009
SP.16.5	June 11, 2007	PD.22.4	June 13, 2005
SP.16.6-7	June 15, 2009	PD.22.5	December 11, 2006
SP.16.8	December 10, 2007	PD.22.6	June 14, 2004
SP.16.9	June 11, 2007	PD.23.1	December 14, 2009
SP.16.10-11	June 16, 2008	PD.23.2	June 16, 2008
SP.16.12	December 15, 2008	* PD.23.3-4	June 14, 2010
SP.16.13-16	June 16, 2008	PD.23.5-7	June 17, 2002
SP.16.17-18	June 12, 2006	* PD.23.8	June 14, 2010
SP.16.19-20	December 11, 2006	PD.23.9-10	June 17, 2002
		PD.24.1-2	June 12, 2006
		PD.24.3	December 14, 2009
		PD.24.4-5	June 12, 2006

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
Performance - Dispatch (cont)		Performance - Dispatch (cont)	
PD.24.6	December 10, 2007	PD.51.1-6	June 15, 2009
PD.24.7	June 12, 2006	PD.51.7	December 14, 2009
PD.24.8	December 15, 2003	PD.51.8-12	June 15, 2009
* PD.TOC.30.1-2	June 14, 2010	PD.52.1-6	June 15, 2009
PD.30.1-9	June 15, 2009	PD.53.1-10	June 15, 2009
PD.30.10-15	December 14, 2009	PD.54.1-2	June 15, 2009
PD.30.16	June 15, 2009	PD.54.3	December 14, 2009
PD.31.1-12	June 15, 2009	PD.54.4-8	June 15, 2009
PD.32.1-6	June 15, 2009	* PD.TOC.60.1-2	June 14, 2010
PD.33.1-2	June 15, 2009	PD.60.1-16	June 15, 2009
* PD.33.3	June 14, 2010	PD.61.1-12	June 15, 2009
PD.33.4-10	December 14, 2009	PD.62.1-6	June 15, 2009
PD.34.1-2	June 15, 2009	PD.63.1-10	June 15, 2009
PD.34.3-8	December 14, 2009	PD.64.1-2	June 15, 2009
* PD.TOC.40.1-2	June 14, 2010	PD.64.3	December 14, 2009
PD.40.1-9	June 15, 2009	PD.64.4-8	June 15, 2009
PD.40.10	December 14, 2009	* PI.TOC.0.1-2	Deleted
PD.40.11	June 15, 2009	Performance - Inflight (tab)	
PD.40.12-15	December 14, 2009	* PI.TOC.1-2	June 14, 2010
PD.40.16	June 15, 2009	* PI.TOC.10.1-4	June 14, 2010
PD.41.1-7	June 15, 2009	* PI.10.1-14	June 14, 2010
PD.41.8	December 14, 2009	* PI.11.1-6	June 14, 2010
PD.41.9-12	June 15, 2009	* PI.12.1-30	June 14, 2010
PD.42.1-6	June 15, 2009	* PI.13.1-10	June 14, 2010
PD.43.1-2	June 15, 2009	* PI.14.1-4	June 14, 2010
* PD.43.3-10	June 14, 2010	* PI.15.1-4	June 14, 2010
* PD.44.1-4	June 14, 2010	* PI.16.1-12	June 14, 2010
PD.44.5-8	December 14, 2009	* PI.TOC.20.1-4	June 14, 2010
* PD.TOC.50.1-2	June 14, 2010	PI.20.1	December 10, 2007
PD.50.1-8	June 15, 2009	* PI.20.2	June 14, 2010

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
Performance - Inflight (cont)		Performance - Inflight (cont)	
PI.20.3-5	December 10, 2007	* PI.TOC.40.1-4	June 14, 2010
* PI.20.6-18	June 14, 2010	PI.40.1	June 15, 2009
PI.21.1-6	December 10, 2007	* PI.40.2	June 14, 2010
* PI.21.7-8	June 14, 2010	PI.40.3-16	June 15, 2009
* PI.22.1-3	June 14, 2010	PI.41.1-8	June 15, 2009
PI.22.4-7	June 16, 2008	* PI.42.1-30	June 14, 2010
PI.22.8	December 14, 2009	PI.43.1-12	June 15, 2009
PI.22.9-10	December 10, 2007	PI.44.1-2	June 15, 2009
PI.23.1-4	December 10, 2007	PI.45.1-8	June 15, 2009
PI.23.5	December 15, 2008	PI.46.1-4	June 15, 2009
PI.23.6-9	December 10, 2007	PI.47.1-12	June 15, 2009
* PI.23.10-11	June 14, 2010	* PI.TOC.50.1-4	June 14, 2010
PI.23.12	June 16, 2008	PI.50.1	June 15, 2009
PI.24.1-4	December 10, 2007	* PI.50.2	June 14, 2010
PI.25.1-6	December 10, 2007	PI.50.3-4	June 15, 2009
PI.26.1-4	December 10, 2007	* PI.50.5-28	June 14, 2010
* PI.26.5-6	June 14, 2010	PI.51.1-10	June 15, 2009
PI.27.1-3	December 10, 2007	PI.52.1-10	June 15, 2009
* PI.27.4	June 14, 2010	PI.53.1-14	June 15, 2009
PI.28.1-14	June 16, 2008	PI.54.1-4	June 15, 2009
* PI.TOC.30.1-4	June 14, 2010	PI.55.1-4	June 15, 2009
PI.30.1	June 15, 2009	PI.56.1-8	June 15, 2009
* PI.30.2	June 14, 2010	PI.57.1-4	June 15, 2009
PI.30.3-32	June 15, 2009	PI.58.1-14	June 15, 2009
PI.31.1-8	June 15, 2009	* PI.TOC.60.1-4	June 14, 2010
* PI.32.1-12	June 14, 2010	PI.60.1	June 15, 2009
PI.33.1-12	June 15, 2009	* PI.60.2	June 14, 2010
PI.34.1-2	June 15, 2009	PI.60.3-15	June 15, 2009
PI.35.1-8	June 15, 2009	* PI.60.16-34	June 14, 2010
PI.36.1-4	June 15, 2009		
PI.37.1-12	June 15, 2009		

* = Revised, Added, or Deleted

Page	Date
Performance - Inflight (cont)	
PI.61.1-8	June 15, 2009
PI.62.1-12	June 15, 2009
PI.63.1-12	June 15, 2009
PI.64.1-2	June 15, 2009
PI.65.1-8	June 15, 2009
PI.66.1-6	June 15, 2009
PI.67.1-12	June 15, 2009
(blank tab)	

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
Volume 2		1 Airplane General, Emergency Equipment, Doors, Windows (cont)	
1 Airplane General, Emergency Equipment, Doors, Windows (tab)		1.40.3	December 15, 2008
* 1.TOC.0.1-6	June 14, 2010	* 1.40.4-6	June 14, 2010
1.10.1-3	December 15, 2008	1.40.7	June 16, 2008
1.10.4	June 15, 2009	1.40.8	June 15, 2009
1.10.5	December 15, 2008	1.40.9	June 16, 2008
1.10.6	June 15, 2009	1.40.10-11	June 15, 2009
1.10.7	December 10, 2007	* 1.40.12	June 14, 2010
1.10.8-10	December 14, 2009	1.40.13-14	June 15, 2009
1.20.1-2	June 26, 2000	1.45.1	December 14, 2009
* 1.21.1-3	June 14, 2010	* 1.45.2-3	June 14, 2010
1.21.4	December 14, 2009	1.45.4-14	June 15, 2009
1.22.1-3	June 26, 2000	* 1.46.1	June 14, 2010
1.22.4-5	June 16, 2003	1.46.2-10	December 15, 2008
* 1.22.6	June 14, 2010	* 1.47.1-3	June 14, 2010
1.22.7-8	June 16, 2003	1.47.4	December 10, 2007
* 1.23.1-3	June 14, 2010	* 1.47.5	June 14, 2010
1.23.4	December 14, 2009	1.47.6	December 10, 2007
* 1.30.1-3	June 14, 2010	* 1.47.7	June 14, 2010
1.30.4-5	June 16, 2008	1.47.8-10	December 10, 2007
1.30.6	December 10, 2007	1.47.11	December 15, 2008
1.30.7-9	June 15, 2009	* 1.47.12	June 14, 2010
1.30.10	June 16, 2008	1.47.13-14	June 15, 2009
* 1.30.11	June 14, 2010	* 1.47.15	June 14, 2010
1.30.12-13	June 15, 2009	1.47.16-21	June 15, 2009
1.30.14	December 15, 2008	* 1.47.22-24	June 14, 2010
1.30.15-28	December 14, 2009	1.47.25-27	June 15, 2009
* 1.30.29	June 14, 2010	* 1.47.28-54	June 14, 2010
1.30.30-34	December 14, 2009	* 1.47.55-56	Deleted
* 1.40.1-2	June 14, 2010	* 1.48.1	June 14, 2010

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
1 Airplane General, Emergency Equipment, Doors, Windows (cont)		2 Air Systems (cont)	
1.48.2	December 14, 2009	2.40.1-2	June 15, 2009
1.48.3-8	June 11, 2007	2.40.3-4	June 16, 2008
1.48.9-10	June 15, 2009	2.40.5	December 14, 2009
1.50.1-2	June 15, 2009	2.40.6	June 16, 2008
1.50.3	December 14, 2009	2.50.1	December 15, 2008
1.50.4	June 15, 2009	2.50.2-3	June 15, 2009
1.50.5	December 14, 2009	2.50.4	June 16, 2008
* 1.50.6	June 14, 2010	3 Anti-Ice, Rain (tab)	
1.50.7-8	June 15, 2009	3.TOC.0.1-2	December 14, 2009
1.50.9-18	December 14, 2009	3.10.1-4	December 14, 2009
1.60.1-3	June 15, 2009	3.20.1	December 16, 2002
1.60.4	June 18, 2001	3.20.2	December 10, 2007
2 Air Systems (tab)		3.20.3-4	December 16, 2002
* 2.TOC.0.1-2	June 14, 2010	3.30.1	June 15, 2009
2.10.1	June 26, 2000	3.30.2	June 26, 2000
2.10.2-10	June 15, 2009	4 Automatic Flight (tab)	
* 2.10.11-20	June 14, 2010	* 4.TOC.0.1-2	June 14, 2010
* 2.20.1	June 14, 2010	4.10.1	June 17, 2002
2.20.2	June 15, 2009	4.10.2	December 12, 2005
2.20.3	June 16, 2008	4.10.3	December 14, 2009
2.20.4	June 15, 2009	4.10.4	December 11, 2006
2.20.5	December 15, 2008	* 4.10.5	June 14, 2010
2.20.6	June 16, 2008	4.10.6	June 26, 2000
2.20.7	December 15, 2008	4.10.7	December 11, 2006
2.20.8-12	June 16, 2008	* 4.10.8-9	June 14, 2010
2.20.13	June 15, 2009	4.10.10	June 13, 2005
2.20.14-16	June 16, 2008	* 4.10.11	June 14, 2010
2.30.1	December 13, 2004	4.10.12-16	December 11, 2006
* 2.30.2	June 14, 2010	4.10.17	June 14, 2004
		4.10.18	June 11, 2007

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
4 Automatic Flight (cont)		5 Communications (cont)	
* 4.10.19	June 14, 2010	* 5.30.2-3	June 14, 2010
4.10.20	December 11, 2000	5.30.4-8	December 10, 2007
4.20.1	June 26, 2000	* 5.30.9	June 14, 2010
4.20.2	December 15, 2008	5.30.10	December 10, 2007
4.20.3-5	December 11, 2000	* 5.40.1	June 14, 2010
4.20.6	June 11, 2007	5.40.2	December 7, 2001
* 4.20.7-11	June 14, 2010	* 5.40.3	June 14, 2010
4.20.12	December 11, 2006	5.40.4-5	December 7, 2001
4.20.13-14	June 11, 2007	5.40.6	June 15, 2009
4.20.15	December 11, 2000	* 5.40.7-62	June 14, 2010
4.20.16-17	June 11, 2007	* 5.40.63-66	Deleted
* 4.20.18-19	June 14, 2010	5.50.1	December 15, 2008
4.20.20	December 11, 2006	5.50.2	June 15, 2009
4.30.1	June 16, 2008	* 5.50.3	June 14, 2010
4.30.2	June 26, 2000	5.50.4	December 15, 2008
5 Communications (tab)		6 Electrical (tab)	
* 5.TOC.0.1-4	June 14, 2010	6.TOC.0.1-2	December 14, 2009
* 5.10.1	June 14, 2010	6.10.1	December 10, 2007
5.10.2	December 15, 2008	6.10.2-4	June 15, 2009
* 5.10.3	June 14, 2010	6.10.5	December 15, 2008
5.10.4	December 15, 2008	6.10.6	December 10, 2007
* 5.10.5	June 14, 2010	6.10.7-8	December 15, 2008
5.10.6-12	December 15, 2008	6.10.9-10	June 16, 2008
* 5.10.13	June 14, 2010	6.10.11-12	December 10, 2007
5.10.14-26	December 15, 2008	6.20.1-7	December 12, 2005
* 5.20.1-4	June 14, 2010	6.20.8	December 10, 2007
5.20.5	December 14, 2009	6.20.9-14	December 12, 2005
* 5.20.6	June 14, 2010	6.20.15-18	June 16, 2008
5.20.7-8	December 14, 2009	6.30.1-2	December 15, 2008
5.30.1	June 15, 2009		

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
7 Engines, APU (tab)		8 Fire Protection (cont)	
* 7.TOC.0.1-4	June 14, 2010	* 8.10.7	June 14, 2010
7.10.1-2	June 26, 2000	8.10.8-10	December 10, 2007
7.10.3-8	June 13, 2005	8.20.1	June 16, 2008
7.10.9	December 12, 2005	8.20.2	December 10, 2007
7.10.10-25	December 14, 2009	8.20.3-4	December 12, 2005
7.10.26	June 13, 2005	8.20.5	December 14, 2009
* 7.10.27	June 14, 2010	8.20.6	December 15, 2008
7.10.28-29	June 13, 2005	* 8.20.7	June 14, 2010
* 7.10.30	June 14, 2010	8.20.8	December 14, 2009
7.10.31	December 14, 2009	8.20.9-11	June 15, 2009
7.10.32	December 11, 2006	8.20.12	December 15, 2008
* 7.20.1-4	June 14, 2010	8.30.1	December 14, 2009
7.20.5-7	June 16, 2008	8.30.2	June 15, 2009
* 7.20.8-17	June 14, 2010	8.30.3-4	June 16, 2008
7.20.18	June 26, 2000	9 Flight Controls (tab)	
7.20.19	June 17, 2002	* 9.TOC.0.1-2	June 14, 2010
7.20.20	June 26, 2000	9.10.1-7	June 26, 2000
7.20.21	June 17, 2002	9.10.8	December 11, 2000
* 7.20.22	June 14, 2010	9.10.9-10	June 15, 2009
7.20.23-27	June 17, 2002	9.10.11-13	June 12, 2006
7.20.28	December 13, 2004	9.10.14-18	December 14, 2009
7.30.1-4	June 26, 2000	9.20.1	June 15, 2009
7.40.1	June 16, 2008	9.20.2-4	June 26, 2000
7.40.2	December 10, 2007	9.20.5	December 15, 2003
7.40.3-4	December 15, 2008	9.20.6	June 26, 2000
8 Fire Protection (tab)		* 9.20.7-22	June 14, 2010
8.TOC.0.1-2	June 15, 2009	* 9.20.23-24	Deleted
8.10.1	June 26, 2000	9.30.1	June 16, 2008
8.10.2-5	December 10, 2007	9.30.2	June 14, 2004
8.10.6	December 14, 2009		

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
10 Flight Instruments, Displays (tab)		10 Flight Instruments, Displays (cont)	
* 10.TOC.0.1-6	June 14, 2010	* 10.30.1	June 14, 2010
10.10.1	June 12, 2006	10.30.2-13	June 15, 2009
* 10.10.2	June 14, 2010	* 10.30.14-15	June 14, 2010
10.10.3-4	December 14, 2009	10.30.16	December 15, 2008
* 10.10.5	June 14, 2010	* 10.30.17-20	June 14, 2010
10.10.6-7	December 14, 2009	10.40.1-2	December 11, 2000
10.10.8-9	December 11, 2006	* 10.40.3-4	June 14, 2010
* 10.10.10	June 14, 2010	10.40.5-9	December 15, 2008
10.10.11	December 11, 2006	* 10.40.10-11	June 14, 2010
10.10.12-13	December 14, 2009	10.40.12-22	December 14, 2009
* 10.10.14	June 14, 2010	* 10.40.23-24	June 14, 2010
10.10.15	December 14, 2009	10.50.1-9	June 26, 2000
10.10.16	June 11, 2007	10.50.10	June 13, 2005
10.10.17-18	December 11, 2006	10.50.11-14	June 26, 2000
10.10.19-22	December 14, 2009	10.50.15	December 7, 2001
10.10.23	December 11, 2006	10.50.16	December 13, 2004
10.10.24	June 11, 2007	10.50.17-18	December 7, 2001
10.10.25-27	December 15, 2008	10.60.1-6	June 26, 2000
10.10.28-29	December 14, 2009	10.60.7	June 16, 2008
* 10.10.30	June 14, 2010	10.60.8-11	December 11, 2000
10.10.31-50	December 14, 2009	10.60.12	June 26, 2000
* 10.10.51-54	June 14, 2010	10.65.1	June 15, 2009
10.10.55-66	December 14, 2009	10.65.2	December 14, 2009
10.20.1	June 26, 2000	10.65.3	December 15, 2003
10.20.2-4	June 14, 2004	10.65.4	June 11, 2007
10.20.5	December 7, 2001	10.65.5	June 14, 2004
10.20.6	June 13, 2005	10.65.6	June 15, 2009
10.20.7-9	June 26, 2000	10.65.7-8	December 11, 2006
10.20.10-11	December 14, 2009	* 10.65.9-38	June 14, 2010
10.20.12-16	December 10, 2007	10.70.1	June 16, 2008

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
10 Flight Instruments, Displays (cont)		11 Flight Management, Navigation (cont)	
10.70.2	June 26, 2000	* 11.34.3	June 14, 2010
11 Flight Management, Navigation (tab)		11.34.4	December 11, 2000
* 11.TOC.0.1-8	June 14, 2010	11.34.5-6	December 14, 2009
11.10.1-3	June 17, 2002	11.34.7-9	June 26, 2000
11.10.4	June 12, 2006	* 11.34.10-12	June 14, 2010
11.10.5-6	June 17, 2002	11.40.1	December 15, 2003
11.10.7	June 16, 2003	11.40.2-3	June 26, 2000
11.10.8-21	June 15, 2009	11.40.4	June 12, 2006
11.10.22-23	December 14, 2009	11.40.5	June 26, 2000
11.10.24	June 15, 2009	11.40.6-8	December 15, 2008
11.20.1-2	December 14, 2009	11.40.9-11	June 14, 2004
11.20.3-4	June 13, 2005	* 11.40.12-14	June 14, 2010
11.20.5	June 15, 2009	11.40.15-16	June 14, 2004
11.20.6	June 13, 2005	11.40.17	June 12, 2006
11.20.7-12	June 11, 2007	* 11.40.18-20	June 14, 2010
11.20.13	June 16, 2008	11.40.21-22	June 14, 2004
11.20.14	June 15, 2009	11.40.23	June 12, 2006
11.20.15	June 16, 2008	11.40.24	June 14, 2004
11.20.16	June 13, 2005	11.40.25	December 11, 2006
11.30.1	June 26, 2000	* 11.40.26	June 14, 2010
11.30.2	June 13, 2005	11.40.27-36	June 15, 2009
* 11.31.1-7	June 14, 2010	* 11.40.37	June 14, 2010
11.31.8-11	December 13, 2004	11.40.38	December 14, 2009
* 11.31.12-14	June 14, 2010	11.40.39-40	June 15, 2009
11.31.15-16	December 13, 2004	11.40.41	December 14, 2009
* 11.31.17-36	June 14, 2010	11.40.42-44	June 15, 2009
11.32.1-2	June 13, 2005	* 11.40.45-46	June 14, 2010
11.32.3-6	June 12, 2006	11.40.47	June 15, 2009
11.33.1-2	June 26, 2000	11.40.48-51	December 14, 2009
11.34.1-2	June 26, 2000	11.40.52	June 15, 2009

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
11 Flight Management, Navigation (cont)		11 Flight Management, Navigation (cont)	
11.41.1	December 14, 2009	11.42.43	June 15, 2009
11.41.2-4	June 11, 2007	11.42.44	June 12, 2006
11.41.5-6	June 13, 2005	11.42.45-46	June 15, 2009
11.41.7	June 16, 2008	11.42.47	June 12, 2006
11.41.8-10	June 13, 2005	11.42.48	June 16, 2008
11.41.11-13	June 11, 2007	11.42.49	June 14, 2004
11.41.14	June 13, 2005	11.42.50	December 11, 2006
11.42.1	June 14, 2004	11.42.51	June 16, 2008
11.42.2-7	June 26, 2000	11.42.52	June 12, 2006
11.42.8-9	December 11, 2000	11.43.1	June 17, 2002
11.42.10-11	June 26, 2000	11.43.2-34	June 16, 2008
11.42.12-13	December 15, 2008	11.50.1	June 26, 2000
11.42.14	June 12, 2006	11.50.2-4	June 16, 2008
11.42.15	December 15, 2008	11.50.5	December 11, 2000
11.42.16-17	June 12, 2006	11.50.6-8	June 15, 2009
11.42.18	June 15, 2009	11.60.1	June 15, 2009
11.42.19	December 14, 2009	11.60.2-5	June 16, 2008
11.42.20-21	June 12, 2006	11.60.6	June 15, 2009
11.42.22	December 14, 2009	11.60.7-8	June 16, 2008
11.42.23	June 12, 2006	12 Fuel (tab)	
11.42.24-25	December 13, 2004		
11.42.26-28	June 15, 2009		
11.42.29-33	December 14, 2009		
11.42.34-35	June 11, 2007		
11.42.36-37	December 14, 2009		
11.42.38	June 12, 2006		
11.42.39	June 15, 2009		
11.42.40	June 12, 2006		
11.42.41	June 15, 2009		
11.42.42	June 14, 2004		
		12.TOC.0.1-2	December 15, 2008
		12.10.1-3	June 16, 2008
		* 12.10.4	June 14, 2010
		12.10.5-9	June 16, 2008
		* 12.10.10	June 14, 2010
		12.10.11-12	December 15, 2008
		12.10.13-16	June 16, 2008
		12.10.17-18	December 15, 2008
		* 12.10.19	June 14, 2010
		12.10.20	December 14, 2009

* = Revised, Added, or Deleted

777 Flight Crew Operations Manual

Page	Date	Page	Date
12 Fuel (cont)		14 Landing Gear (tab)	
12.20.1-3	June 16, 2008	* 14.TOC.0.1-2	June 14, 2010
12.20.4	December 15, 2008	14.10.1-2	December 15, 2008
12.20.5	June 16, 2008	14.10.3	December 11, 2006
12.20.6	December 10, 2007	14.10.4-6	December 15, 2008
12.20.7-8	June 16, 2008	14.10.7-8	June 26, 2000
12.20.9	December 15, 2008	* 14.20.1	June 14, 2010
12.20.10-11	December 10, 2007	14.20.2	June 16, 2008
12.20.12-16	June 16, 2008	14.20.3	December 14, 2009
* 12.20.17	June 14, 2010	* 14.20.4-7	June 14, 2010
12.20.18-20	December 15, 2008	14.20.8	June 16, 2008
12.20.21-24	June 16, 2008	14.30.1-2	June 16, 2008
12.30.1	June 16, 2008	15 Warning Systems (tab)	
12.30.2-3	December 14, 2009	* 15.TOC.0.1-4	June 14, 2010
12.30.4	December 15, 2008	15.10.1-3	December 14, 2009
13 Hydraulics (tab)		15.10.4-5	June 16, 2008
13.TOC.0.1-2	June 16, 2008	15.10.6-8	June 15, 2009
* 13.10.1	June 14, 2010	15.10.9-18	December 14, 2009
13.10.2	June 26, 2000	* 15.10.19-20	June 14, 2010
13.10.3	June 15, 2009	15.10.21-24	December 14, 2009
13.10.4	June 13, 2005	15.20.1	December 14, 2009
13.10.5-6	June 26, 2000	15.20.2	June 11, 2007
13.20.1	June 26, 2000	15.20.3-4	December 14, 2009
* 13.20.2-3	June 14, 2010	* 15.20.5-9	June 14, 2010
13.20.4	December 14, 2009	15.20.10-16	December 14, 2009
13.30.1-2	June 15, 2009	* 15.20.17-38	June 14, 2010
		* 15.20.39-40	Deleted
		15.30.1	June 15, 2009
		* 15.30.2-3	June 14, 2010
		15.30.4	December 14, 2009
		(blank tab)	

* = Revised, Added, or Deleted

Preface**Bulletin Record****Chapter 0****Section 6****General**

The Boeing Company issues Flight Crew Operations Manual Bulletins to provide important information to flight crews prior to the next formal revision of the manual. The transmitted information may be of interest to only specific Operators or may apply to all Operators of this model airplane. Each bulletin will vary.

Bulletins are dated and numbered sequentially. Each bulletin identifies airplanes affected by the bulletin. Absence of airplane effectivity indicates the bulletin applies to all airplanes in an Operator's fleet. When appropriate, the next formal Flight Crew Operations Manual revision will include an updated bulletin record page to reflect current bulletin status.

Bulletin status is defined as follows:

- **In Effect (IE)** – the bulletin contains pertinent information not otherwise covered in the Flight Crew Operations Manual. The bulletin remains active and should be retained in the manual
- **Incorporated (INC)** – the bulletin operating information has been incorporated into the Flight Crew Operations Manual. However, the bulletin remains active and should be retained in the manual
- **Cancelled (CANC)** – the bulletin is no longer active and should be removed from the Flight Crew Operations Manual. All bulletins previously cancelled are no longer listed in the Bulletin Record.

The person filing a new or revised bulletin should amend the Bulletin Record as instructed in the Administrative Information section of the bulletin. When a bulletin includes replacement pages for the Flight Crew Operations Manual or QRH, the included pages should be filed as instructed in the Flight Crew Operations Manual Information section of the bulletin.

Number	Subject	Date	Status
TBC-28 R1	Engine Anti-Ice Operation/Failure Annunciations on the Ground	October 7, 1996	IE
TBC-50 R2	Predictive Windshear Warnings at Kansai Airport, Osaka, Japan	January 19, 2001	IE
TBC-52 R1	ILS/GPS Multi-Mode Receiver (MMR) Failure	April 23, 1999	IE
TBC-55 R2	777 Fuel Quantity Indicating System Fluctuations.	April 15, 2002	IE

Number	Subject	Date	Status
TBC-56 R1	Cabin Pressure Control System Outflow Valve (OFV) Manual Operation	June 14, 2001	IE
TBC-58	Nuisance EICAS Message WINDSHEAR SYS	April 29, 1999	IE
TBC-62 R2	Uncommanded Weather Radar Activation	June 30, 2006	INC
TBC-63 R1	VNAV Altitude Capture Anomaly	June 30, 2006	IE
TBC-64 R1	FMC Reset Following Intercept Course to a Waypoint or Approach Intercept	November 3, 2003	IE
TBC-65 R1	Loss of Engine Response to Thrust Lever Commands on GE90 Engines	September 7, 2001	IE
TBC-66 R1	Door Armed Memo Messages Anomaly	June 30, 2006	IE
TBC-68 R1	GPWS Voice Callouts	August 31, 2001	IE
TBC-72 R1	Uncommanded Movement of Cargo Containers During Power Switching	April 20, 2001	IE
TBC-73 R4	STABILIZER GREENBAND Nuisance EICAS Message	June 15, 2009	IE
TBC-75 R1	Electronic Checklist (ECL) Line Items not Completing Correctly	June 30, 2006	IE
TBC-76 R2	FMC VNAV Anomaly During Intermediate Level Off	June 30, 2006	IE
TBC-77 R2	Takeoff Thrust Shortfall for Airplanes with Pratt and Whitney PW4090-3 and PW4098 Engines	April 25, 2002	IE
TBC-78 R1	Incorrect Performance Predictions during Polar Operations	June 30, 2006	IE
TBC-79 R1	APU Start Failures Due to APU Start Switch	July 1, 2002	IE
TBC-80 R1	NO LAND 3 EICAS Advisory Messages During Cruise Operations	April 15, 2002	IE

777 Flight Crew Operations Manual

Number	Subject	Date	Status
TBC-81 R3	ADIRU Heading Error Anomaly	January 9, 2006	IE
TBC-82 R4	Incorrect Display of Drift Angle	February 13, 2006	IE
TBC-83 R2	Electrical Load Management System (ELMS) ARINC Communication Faults	September 15, 2003	IE
TBC-85	777 FMC Calculation of Reduced Thrust Takeoff Anomaly	June 20, 2003	IE
TBC-87 R3	777 Fuel Quantity Indicating System Fluctuations	July 10, 2006	IE
TBC-88 R1	ENGINE SHUTDOWN L or R EICAS Message Anomaly	June 30, 2006	IE
TBC-90 R1	FMC Departure Routing Anomaly	March 27, 2006	IE
TBC-91 R1	FMC RUNWAY DISAGREE message display anomaly.	March 27, 2006	IE
TBC-92 R2	Fuel Temperature Blanking Indication	August 31, 2006	IE
TBC-93 R2	Incorrect turn direction during a Standard Instrument Departure (SID)	March 27, 2006	IE
TBC-95 R2	New Ice Shedding Procedures for Airplanes with Trent 800 Engines in Freezing Fog	September 25, 2006	IE
TBC-96 R1	False Engine-Out Indication	December 10, 2007	IE
TBC-97 R1	Automatic Re-Boot of Electronic Flight Bag (EFB)	June 30, 2006	IE
TBC-99	GE90-94B Autostart Logic During High Altitude Ground Starts	July 11, 2005	IE
TBC-100 R1	Flight Control Anomaly	January 9, 2006	IE
TBC-101 R1	FMC Performance Predictions Anomaly	June 14, 2010	IE
TBC-102 R2	Fuel Quantity Blanking on the Progress 2/3 Page of the Control Display Unit (CDU)	January 9, 2006	IE

Number	Subject	Date	Status
TBC-103	Fuel Flow Blanking with GE90-100 Series Engines)	February 3, 2006	IE
TBC-104	Generator OFF Light ON After Engine Start With No EICAS Message	September 29, 2006	IE
TBC-105 R2	Incorrect TAKEOFF REF data following a TAKEOFF REF Uplink	June 14, 2010	IE
TBC-107 R2	FMC Minimum V1, VR, V2 Speed Entry Limits for 777-200LR and 777-300ER Models	June 14, 2010	IE
TBC-108 R2	Honeywell Flight Management Computer Anomaly.	June 14, 2010	IE
TBC-111 R3	Cold Fuel Operations Procedures for RR Trent 800 Series Equipped 777 Airplanes	December 14, 2009	INC
TBC-113	Correction and Clarification of Navaid Inhibit supplementary procedure and associated chapter 11 supporting information.	August 12, 2009	CANC
TBC-114	FMC Failure When Programming a "step-down" Descent	December 14, 2009	IE
TBC-115 R1	Uncommanded Autothrottle Movement During Cruise Flight	June 14, 2010	IE
TBC-116	Incorrect Display of Crossbleed (X-BLD) Start Indication	December 21, 2009	IE
TBC-117	Loss of Datalink Function on the Primary VHF Data Radio	January 20, 2010	IE

777 Flight Crew Operations Manual

Number	Subject	Date	Status

Intentionally
Blank



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-28 R1

IssueDate: October 7, 1996

Subject: Engine Anti-Ice Operation/Failure Annunciations on the Ground

Reason: To inform pilots that engine anti-ice system operation on the ground may not be indicated by EICAS with engines at idle thrust.

Revised to show airplane effectivity.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

On the ground, if engine anti-ice selectors are positioned to ON, an EAI annunciation is normally displayed above the EICAS N1 indication for each engine, indicating that the respective engine anti-ice valve is open. At idle thrust, the indicating system may not properly sense the actual valve position.

For this condition, it is necessary for engine thrust to be advanced above idle before valve position information can be sensed and proper annunciations displayed.

Operating Instructions

Effectivity: Airplanes not modified by PRR 61650 or Service Bulletin 777-30-0004.

Operations Manual Information

On the ground, verify proper operation of the engine anti-ice valves by referring to the EAI annunciations above the EICAS N1 indications. If engine anti-ice is selected ON and the EICAS EAI annunciations are not displayed, increase N1 a minimum of 3% above idle. The EICAS EAI annunciation will be displayed for valves that are open. If a valve fails closed, the EICAS advisory message ANTI-ICE ENG L or ANTI-ICE ENG R will be displayed. After confirming valve operation, engine power can be set as required. Properly operating valves will remain open, even though the EAI annunciation may again be blank at idle thrust.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-28 R1 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes in your fleet have been modified by Service Bulletin 777- 30-0004. If you do not plan to modify all your airplanes and would like to have the contents of this bulletin incorporated in your Operations Manual, please advise Boeing accordingly.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-50 R2

IssueDate: January 19, 2001

Subject: Predictive Windshear Warnings at Kansai Airport, Osaka, Japan

Reason: To inform flight crews of false PWS warnings

Revised to provide Service Bulletin information for Rockwell Collins
PWS 622-5132-631 and Rockwell Collins PWS 622-5132-633

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received reports that the Allied Signal Predictive Windshear System (PWS) Part Number 066-50008-0405 and the Rockwell Collins PWS Part Numbers 622-5132-631 and 622-5132-633 delivered on some 777 airplanes, have produced nuisance alerts at Kansai Airport (RJBB), Osaka, Japan. These nuisance alerts may occur during takeoff on RW06 and approach to RW24, and may include the PWS caution (MONITOR RADAR DISPLAY audio alert – approach and takeoff) and the PWS warning (GO AROUND WINDSHEAR AHEAD audio alert – approach, WINDSHEAR AHEAD WINDSHEAR AHEAD audio alert – takeoff). The GPWC Mode 7 reactive windshear system (RWS) warning (WINDSHEAR WINDSHEAR WINDSHEAR audio alert) is not affected by this nuisance condition.

Operating Instructions

Boeing recommends continued use of the PWS. When crews experience a PWS caution or warning alert at Kansai as described above, the alert should be regarded as false and should be ignored by the crew as long as there are no other signs of possible windshear conditions and the reactive windshear system is operational. If in doubt, the crew should treat all predictive windshear warnings as valid. All reactive windshear system warnings should always be treated as valid.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-50 R2 "In Effect" (IE).

For Allied Signal PWS Part Number 066-5008-0405, this condition is corrected by incorporation of Allied Signal Service Bulletin M-4469 (RTA-4B-34-16) which provides a revised PWS database, or Allied Signal Service Bulletin M-4508 (RTA-4B-34-97) which converts the part number from 066-5008-0405 to 066-5008-0406.

For the Rockwell Collins PWS Part Number 622-5132-631, this condition is corrected by incorporation of Rockwell Collins Service Bulletins BH and 217 which install PWS Part Number 622-5132-633 Mod SB217. For the Rockwell Collins PWS Part Number 622-5132-633, this condition is corrected by incorporation of Rockwell Collins Service Bulletin 217 which installs PWS Part Number 622-5132-633 Mod SB217.

This bulletin will be cancelled after Boeing is notified that all affected airplanes have been modified.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-52 R1

IssueDate: April 23, 1999

Subject: ILS/GPS Multi-Mode Receiver (MMR) Failure

Reason: To inform the flight crew of the lack of failure indications associated with a Multi-Mode Receiver (MMR) system processor card failure
Revised to correct technical information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

The Collins MMR combines ILS and GPS functions in a single electronic component. Flight testing has shown certain internal MMR failures can occur leaving the associated ILS and/or GPS inoperative, but without specific MMR failure indications. When this occurs, the approach reference on the PFD (ILS station identifier, or frequency and DME, as appropriate), and localizer/glideslope deviation indicators and scales will not display. The MMR failure may result in a GPS L or GPS R status message. (Status messages are checked prior to flight to determine dispatchability of the airplane and are checked after the flight for possible maintenance action.) The MMR failure may also be indicated by display of the GPS EICAS advisory message. However, this failure may occur and result in no EICAS messages (status or advisory) for the crew

Operating Instructions

If any of the following conditions are observed, the left and/or right ILS receiver(s) may be failed:

- the GPS L or GPS R EICAS status message is observed during preflight on the ground
- the GPS EICAS advisory message is displayed

- absence of the ILS station identifier or frequency and the absence of ILS deviation pointers and ILS scales when the ILS is tuned.

To verify ILS receiver operation:

- Enter an ILS frequency on the FMS-CDU NAV RADIO page (if a frequency is not already entered):
 - Place the captain's and first officer's navigation displays (NDs) in approach (APP) mode and verify the appropriate ILS frequency is displayed on the NDs.
 - If either the captain's or first officer's ILS receiver source is C (center), then the L or R ILS receiver is failed.
 - Failure flags will not be displayed.
 - The NO LAND 3 EICAS message will be displayed on approach.
 - If the captain's or first officer's ILS frequency is not displayed, then multiple ILS receivers are failed.
 - Failure flags will not be displayed.
 - The NO AUTOLAND EICAS message will be displayed on approach.
- Once this test is complete, delete the manually entered ILS frequency, if necessary, to allow ILS autotuning.

If the approach reference is not displayed, assume ILS receiver failure. Triple channel autoland will not be available. Consider the effect on approach minimums and select an appropriate course of action.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-52 R1 "In Effect" (IE).

This condition is temporary until the system is modified. Incorporation of Collins GLU-920 Service Bulletin (8) and Service Bulletins (10 - 15) together constitute the terminating action for the MMR condition.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-55 R2

IssueDate: April 15, 2002

Subject: 777 Fuel Quantity Indicating System Fluctuations

Reason: To inform flight crews of fuel quantity indicating system fluctuations
Revised to include updated Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

777 operators report FUEL IMBALANCE EICAS advisory messages and/or FUEL DISAGREE-PROG 2/3 FMC messages in flight due to fluctuating main and center tank fuel quantity indications. The average erroneous fluctuations have been approximately 3000 lbs / 1400 kgs. Erroneous fuel indications and fluctuations of up to 16,000 lbs / 7300 kgs have been reported. Fluctuating indications will usually result in a sudden fuel quantity decrease of one main tank relative to the other main tank, but have occurred in the center tank also.

Erroneous fuel indications have been observed to either suddenly decrease and recover within several minutes, or remain at a low level for an extended period of time. The events can be a single occurrence or multiple events throughout the flight. To date, these occurrences have occurred during cruise flight, and with different fuel loads.

This condition also results in a difference between the totalizer and calculated fuel quantity indications on the FMC PROGRESS page 2/3. The condition normally does not result in any fuel system status messages and postflight troubleshooting does not reveal any discrepancies. Boeing and Smiths Industries are currently investigating this issue

Operating Instructions

If the FUEL IMBALANCE EICAS advisory message and/or FUEL DISAGREE-PROG 2/3 FMC messages occur in flight, monitor fuel quantity readings to determine if the fuel quantity is fluctuating, or if a true imbalance or fuel leak exists.

If the fuel quantity fluctuates or suddenly decreases and remains at a low level, and an imbalance or fuel leak is not suspected, consider the indications erroneous.

A steady increase in fuel imbalance or steadily increasing difference between fuel totalizer and calculated fuel quantities of approximately 1000 lbs / 500 kgs or more in 30 minutes should be considered a fuel leak. Attempt to confirm any such leak by visual inspection of the wings, struts and engines. If confirmed, accomplish the FUEL LEAK checklist.

To prevent unnecessary fuel balancing, do not accomplish the FUEL IMBALANCE checklist unless an actual fuel imbalance can be confirmed. An actual fuel imbalance can be confirmed by comparison of FMC calculated fuel, comparison of respective engine fuel flows, or other evidence indicating a true imbalance exists.

If the FUEL IMBALANCE procedure is not accomplished because an erroneous indication is suspected, consistent with normal operating techniques, cancel the EICAS message so new messages can be more readily detected.

Note: Even with an actual fuel imbalance of 16,000 lbs / 7300 kgs, airplane handling and/or lateral trim will not be significantly affected.

Note: Should fuel jettison be required with erroneous fuel indications, the fuel jettison system will use the indicated totalizer fuel to determine when to cease jettisoning at the fuel TO REMAIN value set by the crew. Therefore, if the indicated fuel quantity indications are in error, the crew should use the FMC calculated fuel value and determine the jettison time using the jettison rates of 5400 lbs / 2500 kgs per minute with fuel in the center tank, or 3100 lbs / 1400 kgs per minute with center tank empty.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-55 R2 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes in your fleet have been modified by Service Bulletin 777-28-0023.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
777 Model
Boeing Commercial Airplane Group
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207
USA
Fax: (206) 662-7812
Telex: 32-9430 Station 627
SITA: SEABO7X

Intentionally
Blank



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-56 R1

IssueDate: June 14, 2001

Subject: Cabin Pressure Control System Outflow Valve (OFV) Manual
Operation

Reason: To provide flight crews with additional information regarding outflow
valve manual operation

Revised to include updated Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Based on two depressurization events, Boeing feels additional information regarding manual mode operations is warranted.

There is a failure mode that can cause an outflow valve to drive in the direction opposite to the command. The incorrect valve movement is detected and stopped in less than one second. However, cycling between auto and manual mode will reset the fault and allow the outflow valve to drive in the wrong direction each time (automatically in auto and when commanded in manual). Repeated resets could drive an outflow valve progressively further open until airplane pressurization could no longer be maintained

Operating Instructions

If the EICAS advisory message OUTFLOW VALVE AFT or OUTFLOW VALVE FWD is displayed follow the non-normal checklist and close the affected outflow valve in manual mode. If the valve moves in the wrong direction, or does not move after six seconds of switch activation, leave the affected valve in manual mode and do not make any further attempt to drive the valve in either direction. Depending on the position of the affected outflow valve, the other outflow valve may not be able to maintain cabin pressurization.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-56 R1 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes have been modified by PRR 61777-105 (Parts A & B) or Service Bulletin 777-21A0041.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-58

IssueDate: April 29, 1999

Subject: Nuisance EICAS Message WINDSHEAR SYS

Reason: To inform flight crews of predictive windshear system operational conditions that can cause the subject message to be displayed for airplanes with the Allied Signal/Bendix weather radar system receiver-transmitter part number 066-50008-0405 installed.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin applies to the Allied Signal weather radar system with the Predictive Windshear function activated (Allied Signal/Bendix weather radar system receiver-transmitter part number 066-50008-0405).

Flight testing and customer reports have confirmed that a nuisance WINDSHEAR SYS EICAS advisory message will occur for approximately 30 seconds under the following conditions:

- WXR has not been selected ON at any time since electrical power up, and
- one or both engines are above 60% N1 and the indicated airspeed is increasing.

The WINDSHEAR SYS message will annunciate prior to 80 KIAS or after 400 feet AGL. The message will extinguish approximately 30 seconds after appearing.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-58 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes in your fleet have been modified by Allied Signal/Bendix Service Bulletin RTA-4B-34-97 (M4508). This service bulletin converts the weather radar RT unit part number from 066-50008-0405 to 066-50008-0406.

If you modify your fleet using a different Allied Signal/Bendix service bulletin (for example, the RT units are converted from the -405 to the -407 or later configuration), please advise Boeing so this operations manual bulletin can be cancelled.

If you do not plan to modify all your airplanes and would like to have the contents of this operations manual bulletin incorporated in your Operations Manual, please advise Boeing accordingly.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-62 R2

IssueDate: June 30, 2006

Subject: Uncommanded Weather Radar Activation

Reason: To inform flight crews of a condition in which the weather radar transmitter may turn on without crew input following an electrical power interrupt.

Revised to add Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

A system anomaly has been found where the weather radar may automatically start transmitting following a power interrupt. This may occur in flight or on the ground. This anomaly only occurs with Allied Signal/Bendix weather radar with predictive windshear system.

Operating Instructions

To prevent the weather radar from automatically transmitting following a power interrupt on ground, leave the weather radar mode selector in TEST until after engine start. Also, position the weather radar mode selector to TEST after landing.

These procedures have been incorporated into the Normal Procedures chapter.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-62 R2 "In Effect" (IE).

This condition is corrected with installation of Boeing Service Bulletin SB 777-23-0145. This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet have been modified.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
777 Model
Boeing Commercial Airplane Group
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207
USA

Fax: (206) 662-7812
Telex: 32-9430 Station 627
SITA: SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-63 R1

IssueDate: June 30, 2006

Subject: VNAV Altitude Capture Anomaly

Reason: To inform flight crews the airplane may pitch over during VNAV cruise altitude capture at high altitude.

Revised to add Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received several in-service reports of an anomaly that may occur during VNAV cruise altitude capture following VNAV climb. If the FMC cruise altitude is near the FMC maximum altitude, and airplane climb speed is slightly below FMC target cruise speed when cruise altitude capture occurs, the airplane may pitch over and descend attempting to accelerate to FMC target cruise speed. In some cases, thrust reduction has been observed concurrent with the descent.

Operating Instructions

If this anomaly occurs, disconnect the autopilot and autothrottle and manually level the airplane at cruise altitude. Once established at cruise altitude with VNAV PTH mode annunciated, the autopilot and autothrottle may be reconnected.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-63 R1 "In Effect" (IE).

This condition is corrected with installation of AIMS Blockpoint 2001 software (Boeing Service Bulletin SB 777-31-0067). This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet are modified.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
777 Model
Boeing Commercial Airplane Group
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207
USA

Fax: (206) 662-7812
Telex: 32-9430 Station 627
SITA: SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-64 R1

IssueDate: November 3, 2003

Subject: FMC Reset Following Intercept Course to a Waypoint or Approach Intercept

Reason: To inform pilots of system anomalies

Revised to add updated Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

During flight testing, a software reset* of one or both FMCs has been observed when doing an "Intercept Course" to a Waypoint or an "Approach Intercept" while following the steps listed below:

Intercept Course to a Waypoint -

- accomplishing a "direct-to" a waypoint on RTE LEGS page 1, line 1L
- entering a "course to" on RTE LEGS page 1, line 6R
- entering an altitude constraint on either line 4R or 5R of RTE LEGS page 1
- executing the modification.

Approach Intercept -

- accomplishing an approach intercept by selecting the "XXXX INTC>" prompt on the ARRIVALS page for the active route
- entering an altitude constraint on either line 4R or 5R of the RTE LEGS page 1
- executing the modification.

When an entry is made into line 4R or 5R of the RTE LEGS page with an “Intercept Course to a Waypoint” or “Approach Intercept” flight plan modification pending, it is not properly processed and the FMC may experience a software reset.

Note: * For a description of software reset, see chapter 11 (Flight Management, Navigation), section 11.32 (Flight Management Computer), under the paragraph heading "Single FMC Failure."

Operating Instructions

The FMC software reset may be avoided by EXECUTING the “Intercept Course to a Waypoint” or “Approach Intercept” flight plan modification PRIOR to entering waypoint altitude or speed/altitude constraints on lines 4R or 5R on the RTE LEGS page 1.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-64 R1 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes have been modified by Service Bulletin 777-31-0067.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-65 R1

IssueDate: September 7, 2001

Subject: Loss of Engine Response to Thrust Lever Commands on GE90 Engines

Reason: To inform flight crews of the possibility of temporary loss of engine response to thrust lever commands due to an engine sensor problem on GE90 engines, and to provide recommendations to the crew if engine thrust control is not regained prior to landing

Revised to include updated Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received reports of temporary loss of engine response to thrust lever commands resulting from a loss of the combustion chamber burner pressure signal to the EECs. The loss of the burner pressure signal is due to accumulated moisture freezing in the sensing line to the EEC. When this happens, the engine may not respond to thrust lever commands, may only partially respond to thrust lever commands, or may be limited to idle thrust.

To date, there have been six reported events in the 777 GE90 fleet. Four of the six reported events occurred in flight. In each of the four in-flight events, the engine self-recovered during cruise or descent when the accumulated ice in the burner pressure sensing line subsequently thawed. In three of these four in-flight events, engine thrust control restored when the airplane descended to a lower altitude.

There is no direct action the flight crew can take (such as selecting the EEC mode switch to ALTN) that can cause the engine to recover.

Operating Instructions

If loss of thrust lever response is observed on the ground following engine start or if autostart fails to start the engine, do not dispatch. Maintenance action is necessary to purge the burner pressure sensing line of moisture and ice.

If loss of thrust lever response occurs in flight and EGT indications are normal and not increasing, disconnect the autothrottle on the affected engine. Do not retard the thrust lever or shut down the engine as long as thrust levels are acceptable.

If thrust levels become unacceptable, consider a diversion and landing at the nearest suitable airport.

If high engine thrust levels interfere with airspeed control during descent, use speedbrakes and/or landing gear. If engine thrust cannot be reduced to idle prior to landing, the engine should be shutdown. If the engine is above ground idle after landing, the engine should be shutdown.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-65 R1 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes in your fleet have been modified by Service Bulletin number 777-73A0006.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-66 R1

IssueDate: June 30, 2006

Subject: Door Armed Memo Messages Anomaly

Reason: To advise pilots that the DOORS MANUAL, DOORS AUTO, and DOORS AUTO/MANUAL EICAS memo messages (as installed) are not displayed (blanked) when both engines are shut down even though the doors will be in manual, auto, or auto/manual mode.

Revised to add Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Due to an inadvertent change in EICAS message logic in AIMS blockpoint '99 software revision, the door armed memo messages do not display with both engines shut down. Specifically, the DOORS MANUAL, DOORS AUTO, and DOORS AUTO/MANUAL EICAS memo messages do not display on the ground with the engines shut down. With an engine running, the messages display correctly.

Electronic checklist line items that use these memo messages for completion logic will not complete properly when both engines are shut down.

Operating Instructions

On the ground, use the DOORS synoptic or a flight attendant report to confirm door status.

If ECL line items do not complete properly as a result of the Door Armed Message anomaly, use the ECL ITEM OVRD function.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-66 R1 "In Effect" (IE).

This condition is corrected with installation of AIMS Blockpoint 2001 software (Boeing Service Bulletin SB 777-31-0067). This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet are modified.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-68 R1

IssueDate: August 31, 2001

Subject: GPWS Voice Callouts

Reason: To inform flight crews of the possibility of missing the 2500 foot radio altitude voice callout.

Revised to provide updated Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

During an approach over water the voice callout TWENTY FIVE HUNDRED (or RADIO ALTIMETER) may not occur. This callout normally occurs at 2500 feet. However a recent change in the Collins LRA 900 radio altimeter resulted in the unit not reporting 2500 feet to GPWS when over water.

Not all Collins LRA 900 radio altimeters are affected by this problem. For airplanes equipped with Collins LRA 900 radio altimeters not affected by the problem, the voice callout TWENTY FIVE HUNDRED (or RADIO ALTIMETER) will occur correctly at 2500 feet.

Operating Instructions

Do not rely on the voice callout TWENTY FIVE HUNDRED (or RADIO ALTIMETER) during an approach over water.

This bulletin applies to airplanes Boeing delivered with faulty radio altimeters. Airlines may also want to apply this bulletin if they have installed any Collins LRA-900 radio altimeters Part Number 822-0334-002 with serial numbers prior to 780W.

Operations Manual Information

On the ground, verify proper operation of the engine anti-ice valves by referring to the EAI annunciations above the EICAS N1 indications. If engine anti-ice is selected ON and the EICAS EAI annunciations are not displayed, increase N1 a minimum of 3% above idle. The EICAS EAI annunciation will be displayed for valves that are open. If a valve fails closed, the EICAS advisory message ANTI-ICE ENG L or ANTI-ICE ENG R will be displayed. After confirming valve operation, engine power can be set as required. Properly operating valves will remain open, even though the EAI annunciation may again be blank at idle thrust.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-68 R1 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes in your fleet have been modified by Collins LRA-900 Service Bulletin No. 3 titled "Strong Signal Processing Improvement", dated 7 April 2000. If you do not plan to modify all your airplanes and would like to have the contents of this bulletin incorporated in your Operations Manual, please advise Boeing accordingly.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-72 R1

IssueDate: April 20, 2001

Subject: Uncommanded Movement of Cargo Containers During Power Switching

Reason: To inform flight crews of possible uncommanded cargo container movement when switching between ground electrical power and airplane electrical power.

Revised to include Service Bulletin information and revised Background and Operating Information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

One operator has reported cases of uncommanded cargo movement when the airplane electrical power was switched from ground power to airplane power during cargo loading operations. Switching power during cargo loading or unloading may cause the Power Drive Units (PDUs) to retract and allow cargo that has not been restrained to move forward causing a hazard to personnel in the cargo compartment.

Operating Instructions

Do not switch power sources between ground power and airplane power (APU) during cargo loading or unloading without coordinating with ground personnel.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-72 R1 "In Effect" (IE).

This condition is temporary until Service Bulletin 777-25-0181 or production equivalent is installed. This Service Bulletin is expected to be available in the first quarter of 2002.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
777 Model
Boeing Commercial Airplane Group
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207
USA

Fax: (206) 662-7812
Telex: 32-9430 Station 627
SITA: SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-73 R4

IssueDate: June 15, 2009

Subject: STABILIZER GREENBAND Nuisance EICAS Message

Reason: To inform flight crews of nuisance STAB GREENBAND alerts.

Revised to correct kg values in 3 charts and to remove service bulletin information in the Administrative Information section.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received reports of nuisance STAB GREENBAND advisory alerts on 777 airplanes. These nuisance alerts occur prior to departure (at the gate or during taxi for takeoff) after FMC gross weight (GW) and center of gravity (CG) data are entered which result in a nose down forward greenband stabilizer trim calculation. Dispatch delays have resulted.

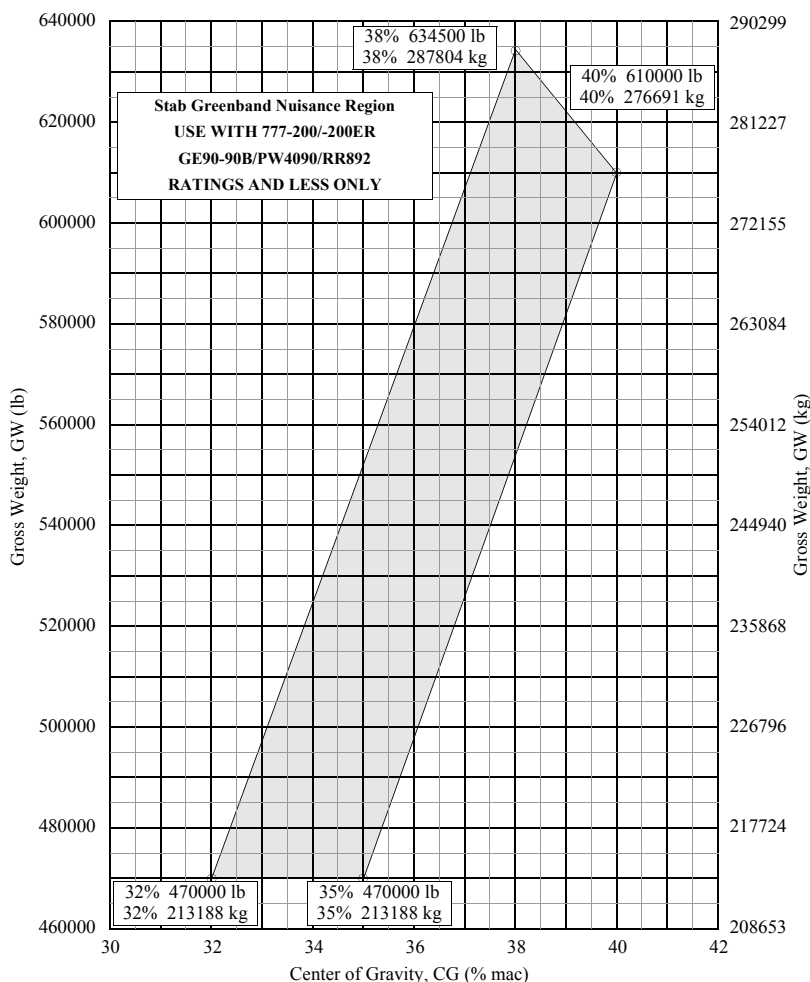
Preliminary investigation indicates that STAB GREENBAND nuisance alerts occur in a small region of the GW and CG envelope where the greenband system has the least margin against nuisance alerts. Boeing has determined that many nuisance messages in the nose down forward greenband can be eliminated by using a fixed and/or assumed temperature derate greater than 15%. Alternatively, the airplane would still be safe to takeoff in this region should the STAB GREENBAND alert be accurate and a real mistrim result. Should a worst case mistrim occur in this range, the column rotation force would be approximately 30-35 pounds. Normal column rotation force is approximately 20-25 pounds.

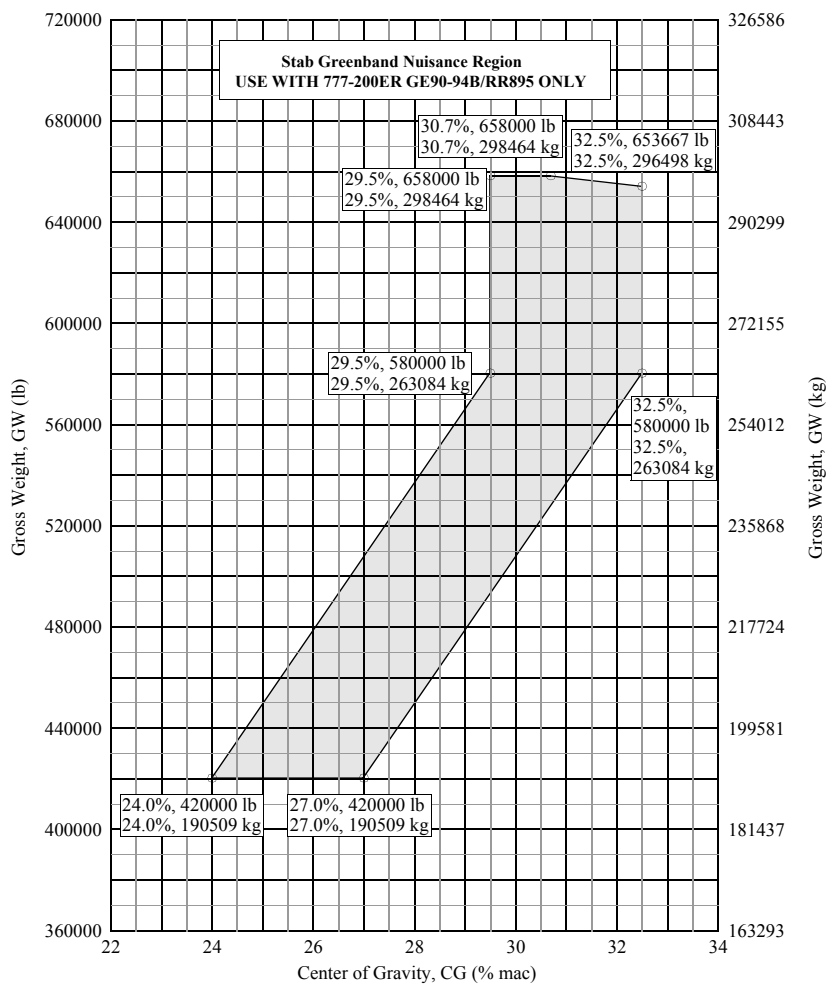
Operating Instructions

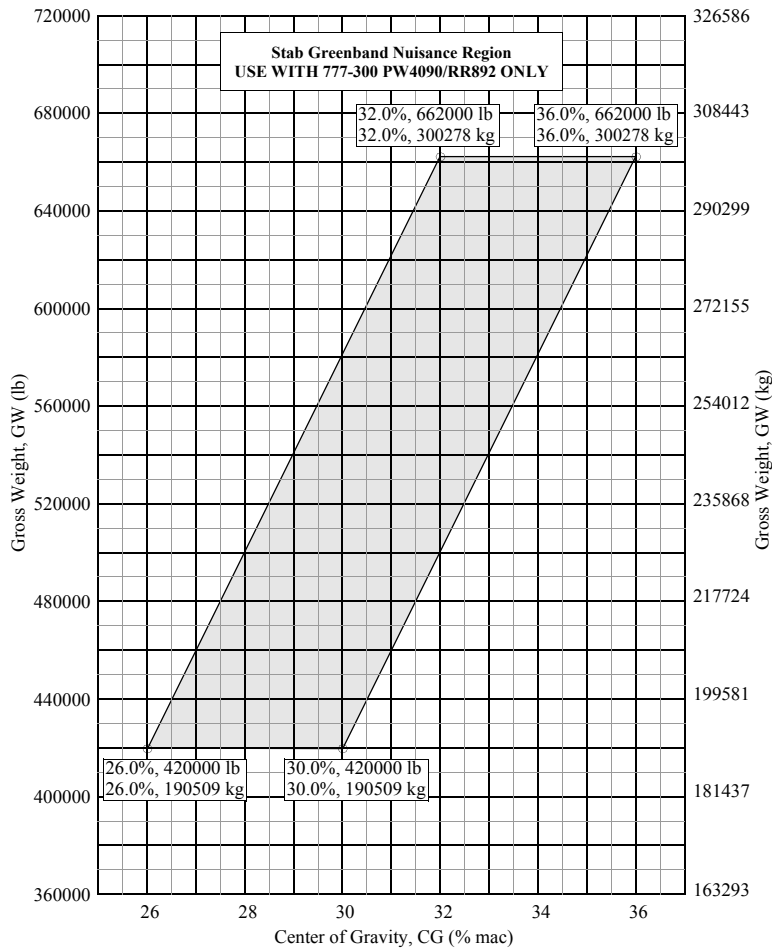
Boeing recommends continued use of the stabilizer greenband monitor and alert. When crews experience a STAB GREENBAND alert after loading is complete:

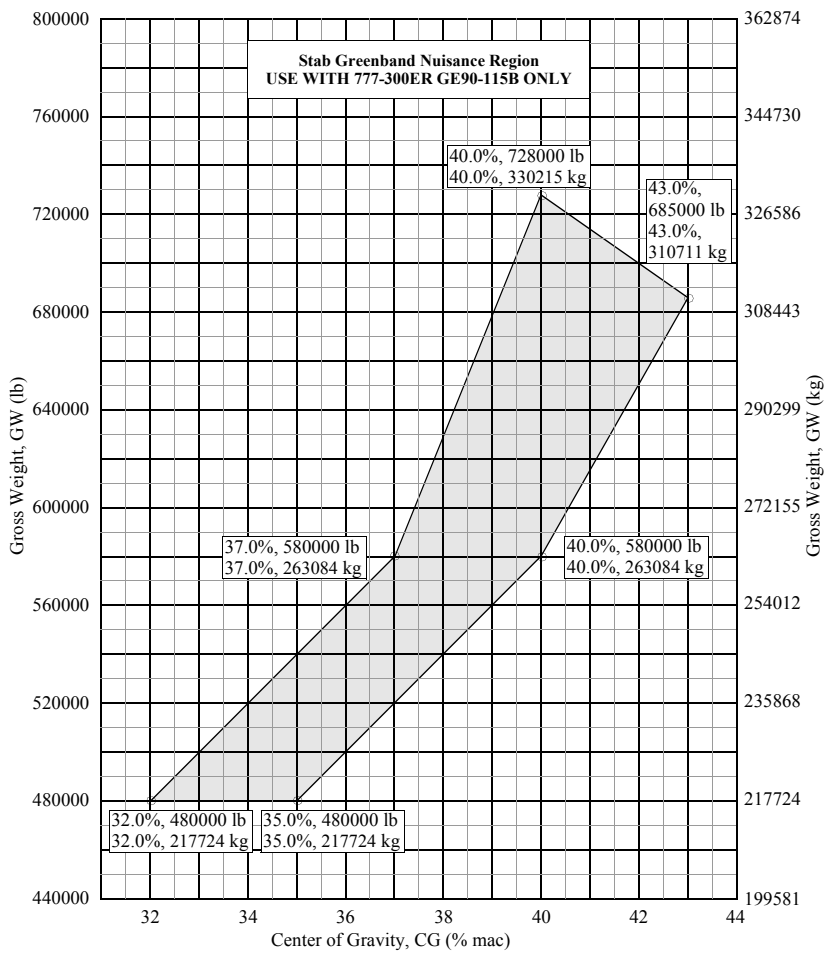
- verify the FMC takeoff data has been correctly entered (takeoff thrust, takeoff flaps, gross weight, and center of gravity)
- verify the stabilizer trim is properly set

If the aircraft GW and CG fall within the Stab Greenband Known Nuisance Region on the following GW-CG charts, the STAB GREENBAND advisory alert may be considered a nuisance and takeoff may be safely conducted. Otherwise, or if in doubt, the alert should be considered valid and the actual loading of the airplane should be verified.









Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-73 R4 "In Effect" (IE).

For airplanes with Nose Gear Pressure Transducers (NGPT), the condition in this bulletin is corrected when SB 777-31-0106 has been incorporated. For airplanes with Nose Gear Pressure Switches (NGPS), the condition in this bulletin is corrected when both SB 777-31-0106 and SB 777-27-0075 have been incorporated. This OMB will be cancelled when Boeing is notified that all airplanes in the customer fleet have the appropriate Service Bulletins incorporated.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X

Intentionally
Blank



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-75 R1

IssueDate: June 30, 2006

Subject: Electronic Checklist (ECL) Line Items not Completing Correctly

Reason: To inform flight crews of a problem with ECL line items not completing correctly and appropriate crew response

Added corrective action information

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received reports from operators of ECL closed loop line items not completing correctly (not changing from white to green) when performing a normal checklist despite the respective switch being selected to the correct position and system operating normally. Boeing engineering has determined that the contacts within the switch which provide switch position to ECL may be intermittent. The affected contacts do not control the system component or function associated with the switch. Switch contact faults can cause ECL line item problems in both normal and non-normal checklists. However, they are most likely when several frequently-used switches must be correctly positioned for the line item to turn green. This occurs with the HYDRAULICS or FUEL items that some operators add to their customized normal checklists. The failure of a switch contact to close or open cannot complete an ECL closed loop line item.

Operating Instructions

If an ECL closed loop line item does not complete as expected, confirm that the switch is positioned correctly. If the system is functioning normally, or is otherwise operating as expected, override the line item and continue with the checklist. The failure of a line item to automatically complete is not indicative of an ECL fault. Therefore, the ECL should continue to be used for all checklists.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-75 R1 "In Effect" (IE).

A vendor design improvement of the push button switches has corrected the problem. Details may be found in Boeing Service Letter 777-SL-31-021. This bulletin will be cancelled when Boeing is notified that the push button switches have been replaced according to the service letter.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-76 R2

IssueDate: June 30, 2006

Subject: FMC VNAV Anomaly During Intermediate Level Off

Reason: To inform pilots of a VNAV anomaly which may result in a level-off altitude error.

Revised to add Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received operator reports of VNAV overshooting the intended altitude following climb. This occurred at intermediate altitudes when the local barometric pressure was significantly lower than standard. Each event occurred when the level-off was initiated shortly after climbing through transition altitude.

The FMC uses a filter to smooth the computed aircraft altitude to compensate for a rapid adjustment to the barometric correction setting. This altitude smoothing function compensates for a barometric correction change at the rate of 1 inch mercury (33.9 hPa) or 1000 feet in two minutes. During climb, when a VNAV level-off is initiated shortly after passing transition altitude and the altimeter is reset from a very low pressure to QNE (29.92 or 1013), VNAV may overshoot the level-off. In descent, an undershoot condition may occur when a VNAV level-off is initiated shortly after passing the transition level and the altimeter has been reset from QNE to a very low pressure QNH setting. The amount of overshoot or undershoot depends on the amount of barometric correction, when the altimeter is reset, and the elapsed time from altimeter reset to level-off.

Operating Instructions

This condition is corrected with the installation of AIMS Blockpoint 2003A software (Boeing Service Bulletin SB 777-31-0087) or AIMS Blockpoint 2003B software (Boeing Service bulletin SB 777-31-0095). This bulletin will be cancelled when Boeing is notified that all airplanes in the customer fleet are modified with either SB 777-31-0087 or SB 777-31-0095.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-76 R2 "In Effect" (IE).

This condition is corrected with the installation of AIMS Blockpoint 2003A software (Boeing Service Bulletin SB 777-31-0087) or AIMS Blockpoint 2003B software (Boeing Service bulletin SB 777-31-0095). This bulletin will be cancelled when Boeing is notified that all airplanes in the customer fleet are modified with either SB 777-31-0087 or SB 777-31-0095.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-77 R2

IssueDate: April 25, 2002

Subject: Takeoff Thrust Shortfall for Airplanes with Pratt and Whitney PW4090-3 and PW4098 Engines.

Reason: To advise flight crews using Pratt and Whitney PW4090-3 and PW4098 engines to perform standing takeoff when wind conditions are ten knots or greater.

Removed effectivity for KAL.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Flight crews have reported lower than expected maximum EPR on their PW4090-3 and PW4098 powered airplanes during takeoff. This shortfall can be identified whenever the Reference/Target EPR indication is above the Maximum EPR line and Actual EPR is unable to achieve Reference/Target EPR.

The shortfall reported by PW4090-3 and PW4098 operators has ranged between 0.1 and 0.01 EPR. The maximum possible shortfall is 0.140 EPR.

The problem is caused by the EEC prematurely setting the takeoff EPR before thrust is set. This can be caused by the EEC having an out-of-tolerance engine P2 sensor, or by a combination of wind and forward speed. Therefore starting the takeoff from a complete stop is necessary when winds are 10 knots or greater.

P2 engine sensor inspections are being recommended and software changes are planned. In the interim, the following operational procedure is required to reduce the probability of a thrust shortfall.

Operating Instructions

If the reported wind from any direction is less than 10 knots, a normal rolling takeoff is permissible.

If the reported wind is 10 knots or greater, come to a complete stop on the runway, then release brakes and accomplish a normal takeoff procedure.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-77 R2 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes have been modified by PRR 62777-145 or Service Bulletin 777-73A0010.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-78 R1

IssueDate: June 30, 2006

Subject: Incorrect Performance Predictions during Polar Operations

Reason: o inform pilots of an FMS anomaly.

Revised to add Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Operators have reported intermittent occurrences of incorrect performance predictions during polar operations. During these events, the crew observed unrealistic ETA and FUEL predictions to downpath waypoints and the destination. In some cases, the ETA to the destination increased substantially beyond the planned ETA and the INSUFFICIENT FUEL message was subsequently displayed. Crews have reported and Boeing has confirmed in laboratory tests that when the anomaly occurs, the incorrect predictions will be displayed on the PROGRESS and POS REPORT pages after the airplane has passed abeam the pole.

Operating Instructions

If the ETA and FUEL at the active waypoint and/or destination changes significantly from the planned values while in the polar region, perform a “direct-to” entry (1L-1L) to the active waypoint on the LEGS page. The “direct-to” entry causes LNAV to recalculate the leg distance and the performance predictions. Following the “direct-to” entry, all predictions will return to normal.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-78 R1 "In Effect" (IE).

This condition is corrected with installation of AIMS Blockpoint 2001 software (Boeing Service Bulletin SB 777-31-0067). This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet are modified.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-79 R1

IssueDate: July 1, 2002

Subject: APU Start Failures Due to APU Start Switch

Reason: To advise flight crew when starting the APU to manually position APU Start Switch to ON after selecting START.

Revised to add Service Letter information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

The APU Selector has caused failed APU starts on 777 airplanes. Testing of the APU selector has shown that the internal contacts may not make a proper connection when the selector is momentarily placed to the START position and allowed to spring back to the ON position. This condition can be avoided if the pilot manually places the APU Selector to ON after selecting START.

Operating Instructions

When starting the APU, position the APU selector to the START position and hold it there for one second. Then, position the APU selector to ON manually. Do not allow the APU selector to spring back to the ON position.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-79 R1 "In Effect" (IE).

Boeing Service Letter 777-SL-49-012, dated 22 May, 2002, “APU Start Failure due to APU Start Switch” provides instructions on how to replace the faulty switch. This bulletin will be cancelled when Boeing is notified that the switch has been replaced. A Service Bulletin will not be issued.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-80 R1

IssueDate: April 15, 2002

Subject: NO LAND 3 EICAS Advisory Messages During Cruise Operations

Reason: To notify flight crews of nuisance NO LAND 3 EICAS alerts

Revised to include updated Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

There have been a number of reports of “NO LAND 3” EICAS advisory messages during cruise. The condition responsible for generating this message has been found to occur randomly, usually when the autopilot is engaged during LNAV or VNAV (or both) mode operation. It occurs when a single Primary Flight Computer (PFC) identifies a fault in an Autopilot Flight Director Computer (AFDC) and inhibits it from operation. This results in the “NO LAND 3” EICAS alert.

Boeing has not yet determined the root cause, however the anomaly is of a temporary nature, and of a magnitude which is not detectable by the self monitoring functions within the AFDCs themselves. Maintenance investigations performed after these events consistently show no faults in the affected AFDC. Boeing is actively cooperating with several airlines to capture data related to these occurrences to expedite addressing this problem.

Operating Instructions

If a NO LAND 3 alert occurs during flight, disengage and re-engage the autopilot. If the condition was caused by the fault described above, this procedure will restore LAND 3 autoland capability and eliminate the NO LAND 3 message. This procedure to restore autoland capability should only be attempted once during a flight.

If the "NO LAND 3" Advisory is caused by some other failure (sensor, LRU etc.), this procedure will not result in clearing the EICAS advisory or restoring Autoland capability.

Operations Manual Information

On the ground, verify proper operation of the engine anti-ice valves by referring to the EAI annunciations above the EICAS N1 indications. If engine anti-ice is selected ON and the EICAS EAI annunciations are not displayed, increase N1 a minimum of 3% above idle. The EICAS EAI annunciation will be displayed for valves that are open. If a valve fails closed, the EICAS advisory message ANTI-ICE ENG L or ANTI-ICE ENG R will be displayed. After confirming valve operation, engine power can be set as required. Properly operating valves will remain open, even though the EAI annunciation may again be blank at idle thrust.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-80 R1 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes in your fleet have been modified by Service Bulletin 777-22-0013.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-81 R3

IssueDate: January 9, 2006

Subject: ADIRU Heading Error Anomaly

Reason: To inform flight crews of possible heading errors following on-ground automatic realignment of the ADIRU.

Revised to include new Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

If the ADIRU is navigating and the airplane stops for a predetermined period of time (between 5 and 15 minutes depending on latitude), the ADIRU conducts an automatic realignment designed to remove navigation errors by updating attitude, heading, and velocity.

Analysis of a recent event has shown that if the airplane is moved precisely at the moment automatic realignment completes, the updated information will be saved and subsequently implemented if the airplane becomes motionless again for more than one minute. The heading update will be implemented regardless of the actual airplane heading at the time of update. Heading errors of up to 180 degrees may be introduced by the update. Smaller, less noticeable attitude and/or heading errors affecting navigation functions may also be introduced during the update. However, ADIRU attitude outputs to the Primary Flight Displays will not be adversely affected.

The ADIRU heading error anomaly can only occur on the ground, and may be detected by comparing the airplane's heading with a known heading.

This anomaly has an extremely low probability of occurrence and has only been reported once in-flight.

In-flight, symptoms of this problem may include one or more of the following:

- Erroneous headings up to 180 degrees from actual heading
- NAV ADIRU INERTIAL caution alert, if the magnitude of the errors are large enough for the ADIRU to detect the fault
- if NAV ADIRU INERTIAL alert is displayed, passenger entry flight locks will disengage and the status message DOOR FLIGHT LOCK XX for each door will be set
- angular difference in the displayed airplane track and the active leg while in LNAV
- LNAV difficulty in precisely tracking the active leg, particularly during turns, resulting in cross-track errors
- ETA to the active waypoint may be inaccurate
- presence of an erroneous crosswind on the navigation display
- NO AUTOLAND (caution) or AUTOPILOT alert messages and/or absence of FLARE arm or ROLLOUT arm indications when an automatic approach is attempted. F/D operation will be similarly affected and may not display appropriate commands
- degraded or inoperative SATCOM, TCAS and ACARS may be affected. SATCOM, TCAS, and DATALINK LOST alerts may be displayed
- NO AUTOLAND (advisory), GROUND PROX SYS, ALT CALLOUTS, and WINDSHEAR SYS alerts may be displayed.

The magnitude and effect of the above symptoms may vary as the flight progresses.

ADIRU air data functions will not be affected. The FMC will use GPS position if it is available. ANP will not be affected and the LNAV path displayed on the ND will be accurate and reliable if GPS is the FMC update source.

Operating Instructions

Prior to takeoff, align the airplane with the runway and check the displayed heading is within +/- 10 degrees of the runway magnetic heading. If the heading is not within +/- 10 degrees of the runway magnetic heading exit the runway, set the parking brake and perform a complete ADIRU alignment.

If the problem is detected after airborne, LNAV may be used as long as course tracking is satisfactory. If autopilot course or heading control is unsatisfactory, disconnect the autopilot, turn off the F/Ds and fly the airplane manually with reference to the standby magnetic compass and the displayed course. If heading errors are significant, consider landing at the nearest suitable airport.

Accomplish the NAV ADIRU INERTIAL checklist as appropriate. Autoland should be monitored for proper operation. If autoland operation is not satisfactory, disconnect the autopilot, turn off the F/Ds and accomplish a manual approach using raw data.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-81 R3 "In Effect" (IE).

This bulletin was previously cancelled with the incorporation of Service Bulletin 777-34-0082. However, bulletin TBC-100 identifies an anomaly that is corrected with the incorporation of Boeing Alert Service Bulletin SB 777-34A0137. When SB 777-34A0137 is incorporated, the anomaly described in this bulletin applies again. This bulletin is re-issued to cover those cases where SB 777-34A0137 has been incorporated.

Boeing Alert Service Bulletin SB 777-34A0138 corrects the anomaly associated with this bulletin and corrects for the impact of incorporating SB 777-34A0137. This bulletin will be cancelled when Boeing is notified that SB 777-34A0138 has been incorporated in the customer fleet.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X

Intentionally
Blank



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-82 R4

IssueDate: February 13, 2006

Subject: Incorrect Display of Drift Angle

Reason: To inform pilots of potential drift angle discrepancies on the Primary Flight Display (PFD) and the Navigation Display (ND)

Revised to include AIMS software upgrade Service Bulletins as part of closing action.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

A difference in Magnetic Variation (MagVar) tables between the ADIRU and FMC has introduced a drift angle anomaly on the PFD and ND at some geographic locations. This anomaly is a result of installing ADIRU Operational Program Software version 3470-HNC-100-03 as required by Alert Service Bulletin 777-34A0137.

ADIRU software version -03 contains the year 1995 MagVar table while the FMC software version starting with AIMS BP03 contains the year 2005 MagVar table. The drift angle anomaly results from magnetic heading computations that use the ADIRU's 1995 MagVar table and magnetic track computations that use the FMC's newer 2005 MagVar table.

While on the ground a difference between the magnetic track and magnetic heading may be observed. The same anomaly may also be observed in flight.

Analysis has shown that the difference between track and heading varies (assuming zero wind) with geographic location. At latitudes between 50 degrees North and 50 degrees South, the maximum track/heading difference can reach 2.5 degrees, but is typically less than 1.8 degrees.

In the northern hemisphere above 50 degrees North latitude, the maximum difference can reach approximately 19 degrees (near N82 W130), however typical errors are less than 6.5 degrees. The greatest errors occur in the region surrounding the North magnetic pole. The specific areas include most of Alaska, the Canadian Provinces of the Yukon, NW Territories and Nunavut, and most of Greenland. In the southern hemisphere below 50 degrees South latitude, the maximum error can reach approximately 5.4 degrees, but is typically less than 1.9 degrees.

This discrepancy is not observed above 82 degrees North and South latitudes or in the vicinity of the magnetic poles because only true referenced heading and track are displayed in these areas. Drift angle is also correctly displayed when the Heading Reference switch is placed in TRUE. Magnetic referenced wind direction is calculated with the ADIRU MagVar so it will be represented correctly relative to the magnetic heading indication.

Operating Instructions

At lower latitudes an erroneous difference between track and heading will be imperceptible in flight. At higher latitudes, crews may be able to notice track and heading differences that are inconsistent with actual wind drift. If desired, correct drift angle can be verified by momentary selection of the HDG REF switch to the TRUE position. The autopilot uses FMC track during LNAV cruise and ADIRU track for approach and landing. Although at some locations, the displays may present an apparent large difference between magnetic track and heading, all FMC and autopilot functions will behave correctly including all selectable roll modes. LNAV course tracking is unaffected by this anomaly.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-82 R4 "In Effect" (IE).

This bulletin was previously cancelled with the incorporation of AIMS BP 2003 software. However, bulletin TBC-100 identifies an anomaly that is corrected with the incorporation of Boeing Alert Service Bulletin SB 777-34A0137. When SB 777-34A0137 is incorporated, the anomaly described in this bulletin applies again. This bulletin was previously re-issued to cover those cases where SB 777-34A0137 has been incorporated.

Boeing Alert Service Bulletin SB 777-34A0138 along with the appropriate AIMS software upgrade corrects the anomaly associated with this bulletin, and also corrects for prior incorporation of SB 777-34A0137.

This bulletin will be cancelled when Boeing is notified SB 777-34A0138 and one of the applicable AIMS software upgrade service bulletins listed below is also incorporated in all affected airplanes:

- For AIMS-1 operators - either SB 777-31-0087 or SB 777-31-0104

- For AIMS-2 operators - SB 777-31-0095.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
 777 Model
 Boeing Commercial Airplane Group
 P.O. Box 3707 M/C 20-89
 Seattle, WA 98124-2207
 USA

Fax: (206) 662-7812

Telex: 32-9430 Station 627

SITA: SEABO7X

Intentionally
Blank



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-83 R2

IssueDate: September 15, 2003

Subject: Electrical Load Management System (ELMS) ARINC Communication Faults

Reason: To inform flight crews of a problem where ELMS ARINC communication data is lost.

Revised to add Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Operators have reported a significant increase in EICAS ELMS P110, P210 and P310 status messages. These messages display when ARINC 629 output data from the respective ELMS panel is lost. The ELMS panels continue to receive data over the ARINC 629 bus and are able to control their various systems even though the panel output is not being transmitted on the ARINC 629 bus. Because of the lack of output data on the bus, some airplane systems will appear faulted when they are not, and some airplane systems may not display EICAS alert or status messages when faults actually occur.

Operating Instructions

If the EICAS status message ELMS P110 PANEL displays:

The following EICAS messages will also display and should be considered valid messages:

EICAS ADVISORY message

- CARGO HEAT AFT
- EICAS STATUS messages

- AIR/GROUND L
- CARGO EXH FAN FWD
- EQUIP VENT FAN
- IFES COOLING FAN
- LAV-GALLEY FAN L
- RECIRC FAN
- SATCOM COOLING FAN L

Note: Some messages above may not apply depending on airplane configuration.

Should the associated system fault occur while the ELMS P110 PANEL status message is displayed, the following EICAS messages will NOT display because of the ELMS ARINC communication fault:

EICAS ADVISORY messages

- FUEL CROSSFEED FWD
- FUEL PUMP CENTER L
- FUEL PUMP L AFT
- FUEL PUMP R FWD

The electrical synoptic will indicate that the left and right main AC bus and left transfer bus are not powered even though they are powered.

The fuel synoptic indications and flow bars for the left aft fuel pump, right forward fuel pump, left center fuel pump and forward crossfeed valve will be blank.

During fuel jettison, the synoptic indications and flow bars for the left main jettison pump, the left jettison isolation valve, and the left jettison nozzle valve indications will be blank. Fuel jettison will be normal unless the system is not fully operational.

The fuel imbalance pointer will not flash if fuel balancing is going in the wrong direction.

On the overhead panel, the left aft, right forward and left center pump “PRESS” lights will not illuminate. The forward crossfeed and the left jettison nozzle valve “VALVE” lights will not illuminate.

If the EICAS status message ELMS P210 PANEL displays:

The following EICAS messages will also display and should be considered valid messages:

EICAS ADVISORY message

- CARGO HEAT BULK
- EICAS STATUS messages
- AIR/GROUND R
- CARGO VENT FAN BULK

- RAT GEN HEAT
- RECIRC FAN

Note: Some messages above may not apply depending on airplane configuration.

Should the associated system fault occur while the ELMS P210 PANEL status message is displayed, the following EICAS messages will NOT display because of the ELMS ARINC communication fault:

EICAS ADVISORY messages

- FUEL PUMP CENTER R
- FUEL PUMP R AFT

The electrical synoptic will indicate that the right main AC bus and right transfer bus are not powered even though they are powered.

The fuel synoptic indications and flow bars for the right aft fuel pump and right center fuel pump will be blank.

During fuel jettison, the synoptic indications and flow bars for the right main jettison pump, the right jettison isolation valve, and the right jettison nozzle valve indications will be blank.

The fuel imbalance pointer will not flash if fuel balancing is going in the wrong direction.

On the overhead panel, the right aft and right center pump “PRESS” lights will not illuminate. The right jettison nozzle valve “VALVE” light will not illuminate.

If the EICAS status message ELMS P310 PANEL displays:

The following EICAS messages will also display and should be considered valid messages:

EICAS ADVISORY message

- NO LAND 3

EICAS STATUS messages

- AIR/GROUND R
- NO LAND 3

Should the associated system fault occur while the ELMS P310 PANEL status message is displayed, the following EICAS messages will NOT display because of the ELMS ARINC communication fault:

EICAS ADVISORY messages

- ELEC BATTERY OFF
- ELEC STANDBY SYS
- FUEL CROSSFEED AFT
- FUEL PUMP L FWD

- FUEL VALVE APU
- MAIN BATTERY DISCH
- PASS OXYGEN ON

The electrical synoptic indication “CHG/DISCH” for the main battery will not display.

The fuel synoptic indications and flow bars for the left forward fuel pump and aft crossfeed valve will be blank.

The fuel imbalance pointer will not flash if fuel balancing is going in the wrong direction.

On the overhead panel, the left forward pump “PRESS” light will not illuminate. The aft crossfeed valve “VALVE” light will not illuminate. The passenger oxygen “ON” light will not illuminate.

Operating Instructions

If EICAS alert messages display, perform the associated non-normal checklist as required.

During fuel balancing, make sure fuel is being balanced in the correct direction.

Once fuel jettison is initiated, it must be terminated by manually turning off the fuel jettison nozzle valves if the EICAS status messages ELMS P110 PANEL or ELMS P210 PANEL display. Automatic shutoff of the fuel jettison system is inoperative.

Fuel jettison is not possible if both EICAS status messages ELMS P110 PANEL and ELMS P210 PANEL are displayed.

Do not use synoptic displays to perform procedures.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-83 R2 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes have been modified by Service Bulletin 777-24-0087.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
777 Model
Boeing Commercial Airplane Group
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207
USA
Fax: (206) 662-7812
Telex: 32-9430 Station 627
SITA: SEABO7X

Intentionally
Blank



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-85

IssueDate: June 20, 2003

Subject: 777 FMC Calculation of Reduced Thrust Takeoff Anomaly

Reason: To inform flight crews of a thrust setting anomaly associated with derated thrust takeoff selection.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received reports of anomalous FMC calculation of derate takeoff (TO 1 or TO 2) thrust settings. The percent thrust reduction associated with TO 1 and TO 2 on the FMC THRUST LIM page can display zero (0). This anomaly seems to occur at power up, after a data load, or after FMC reset. When this occurs, selection of TO 1 or TO 2 does not result in derated thrust. The Takeoff EPR/N1 Limit displayed on line 1R of the FMC THRUST LIM page is full rated thrust (TO); however, FMC V speeds may be based on the selected derate. If an assumed temperature has been entered, the resulting thrust reduction is relative to full rated thrust, not the intended derate.

Operating Instructions

Takeoffs using full rated thrust are not affected by this anomaly. If intending to use derates TO 1 or TO 2, verify the appropriate percentage thrust reduction displays under TO 1 or TO 2 on the FMC THRUST LIM page. If the displayed percentage thrust reduction associated with TO 1 and TO 2 is zero (0), FMC selection of derates is not available. Flight crew action should be based on airline policy; however, the following thrust setting options are available:

- Use full rated thrust (TO) with appropriate V speeds, if conditions permit.

- Use the assumed temperature method with full rated thrust (TO) and appropriate V speeds, if conditions permit.
- Set EPR/N1 manually for the intended derate. Derate thrust settings and appropriate V speeds can be obtained from company airport analysis or from the Flight Planning and Performance Manual, Section 1.3.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-85 "In Effect" (IE).

This condition is under investigation. This bulletin remains in effect until further notice.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-87 R3

IssueDate: July 10, 2006

Subject: 777 Fuel Quantity Indicating System Fluctuations

Reason: To inform flight crews of fuel quantity indicating system fluctuations.
Revised Operating Instructions.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

777 operators report FUEL IMBALANCE EICAS advisory messages and/or FUEL DISAGREE-PROG 2/3 FMC messages in flight due to fluctuating fuel quantity indications. Fluctuating indications are due to an internal FQIS anomaly and will usually result in a constant rate decrease of approximately 600 lbs / 270 kgs per minute in the Left Main, Right Main, or Center fuel tank quantity. Typical cruise fuel flow is approximately 125 lbs / 55 kgs per minute per engine. The erroneous fuel indications and resultant messages have been observed to recover within several minutes, but may repeat throughout the flight.

Operating Instructions

If any of the following are observed, flight crews should accomplish the FUEL LEAK CHECKLIST:

- Visual observation of fuel spray from strut/engine
- Excessive engine fuel flow
- Control wheel deflection to maintain lateral trim

One or more of the following may also be evidence of a fuel leak or the FQIS anomaly described above:

- Total fuel quantity decreasing at an abnormal rate

- FUEL IMBALANCE message on EICAS
- FUEL QTY LOW message on EICAS
- FUEL DISAGREE –PROG 2/3 message on CDU scratchpad (pre-AIMS 05)
- FUEL DISAGREE message on EICAS (AIMS 05 and later)
- INSUFFICIENT FUEL message on CDU scratchpad

A fuel quantity decrease of approximately 600 lbs / 270 kgs per minute in one tank may be the result of the subject FQIS anomaly. This anomaly could trigger the FUEL IMBALANCE, FUEL DISAGREE, FUEL QTY LOW, and/or INSUFFICIENT FUEL messages. Allow 15 minutes for the FQIS to recover and display accurate fuel quantities. If the message(s) remain after this time, consider them valid and take appropriate action.

Note: Should fuel jettison be required with erroneous fuel indications, the fuel jettison system will use the indicated totalizer fuel to determine when to cease jettisoning at the fuel TO REMAIN value set by the crew. Therefore, if the indicated fuel quantity indications are in error, the crew should use the FMC calculated fuel value and determine the jettison time using the jettison rates of 5400 lbs / 2500 kgs per minute with fuel in the center tank, or 3100 lbs / 1400 kgs per minute with center tank empty.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-87 R3 "In Effect" (IE).

This condition is corrected by Boeing Service Bulletin SB 777-28-0043.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-88 R1

IssueDate: June 30, 2006

Subject: ENGINE SHUTDOWN L or R EICAS Message Anomaly

Reason: To inform flight crews that the ENGINE SHUTDOWN L or ENGINE SHUTDOWN R caution message may display for approximately one second after selecting the Fuel Cutoff Switch to the RUN position when starting the second engine. This is a ground condition only.

Revised to add Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Effectivity: All airplanes with AIMS Blockpoint 2003 Software installed.

During flight testing, the EICAS caution message ENGINE SHUTDOWN L was observed for approximately one second after selecting the left Fuel Cutoff Switch to the RUN position. The right engine had already been started. During a subsequent test flight, the EICAS caution message ENGINE SHUTDOWN R was also observed under the same conditions during right engine start when the left engine had already been started.

The EICAS caution messages ENGINE SHUTDOWN L, R are not accompanied by the Master Caution Light annunciation or Caution aural sound.

This anomaly is due to a software timing issue within AIMS Blockpoint 2003 software. Boeing and Honeywell have determined the cause of this anomaly. It will be corrected in the next AIMS software revision.

Operating Instructions

The EICAS caution message ENGINE SHUTDOWN L or ENGINE SHUTDOWN R may display for approximately one second after the Fuel Cutoff Switch is moved to the RUN position during a normal start of the second engine. This is a nuisance message. No pilot action is required if the message clears within approximately one second and all other EICAS Engine parameters indicate a normal engine start.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-88 R1 "In Effect" (IE).

This condition is corrected with the installation of AIMS Blockpoint 2003B software (Boeing Service bulletin SB 777-31-0095). This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet are modified with SB 777-31-0095.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-90 R1

IssueDate: March 27, 2006

Subject: FMC Departure Routing Anomaly

Reason: To direct flight crews to use the LEGS page to remove discontinuities after entering departure procedures in the FMC.

Revised to add service bulletin information

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

An operator recently reported the FMC changed waypoints on a selected departure procedure when the flight crew removed a discontinuity between the departure procedure and route using the RTE page. Engineering investigation by Boeing revealed an FMC software anomaly can cause substitution of waypoints when a departure procedure applies to multiple runways, and a RTE page entry modifies the departure routing. In this situation, the FMC can substitute the departure waypoints that apply to another runway at the origin airport. The change may not be noticed on the ND even though the magenta line and LEGS page waypoints display it. If not corrected prior to departure, the anomaly can result in the flight director commanding an immediate turn when LNAV engages after takeoff.

The only reported occurrence of this anomaly has been on the Narita Reversal Eight Departure, Kisaruzu (KZE) Transition when departing runway 16R. However, the software anomaly could conceivably cause a similar problem at other airports.

This anomaly does not occur if departure routing discontinuities are removed on the LEGS page.

Operating Instructions

After selecting runway, SID and transition, verify SID and departure route are correct on the RTE page. Remove any discontinuities in departure routing on the LEGS page.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-90 R1 "In Effect" (IE).

This condition is corrected with the installation of AIMS BP05A software. The applicable Boeing service bulletin depends on the AIMS hardware installation:

- AIMS-1 hardware airplanes - SB 777-31-0098.
- AIMS-2 hardware airplanes - SB 777-31-0097.

This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet have the applicable service bulletin incorporated.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-91 R1

IssueDate: March 27, 2006

Subject: EICAS Caution Message FMC RUNWAY DISAGREE Alerting.

Reason: To inform flight crews the FMC RUNWAY DISAGREE message may not display for lateral runway position errors.

Revised to add service bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin applies to all airplanes with optional FMC RUNWAY DISAGREE message.

The EICAS caution message FMC RUNWAY DISAGREE displays when the airplane position or heading is not lined up within specified limits of the active FMC departure runway and takeoff thrust is applied. GPS updating is required to enable sensing of position errors; heading errors will trigger the message even if GPS updating is disabled or unavailable.

On a recent test flight the EICAS Caution message FMC RUNWAY DISAGREE failed to display when the airplane was lined up on a parallel runway approximately 1000 feet from the FMC departure runway. The message displayed correctly when first tested at this location, then failed to display on another test at the same location approximately 20 minutes later.

Subsequent investigation indicates that the lack of consistent alerting was caused by variability of an overly conservative GPS parameter used in the FMC. The following table shows the approximate probability of a valid FMC RUNWAY DISAGREE message being displayed at various distances from the departure runway.

Distance (feet)	400	600	800	1000	1200
Probability of alert	10%	50%	78%	92%	97%

As an example, the parallel runways at San Francisco (KSFO) are spaced about 800 feet apart. The current system will only provide an alert about 78% of the time if takeoff power is applied when lined up on the wrong parallel runway.

The FMC RUNWAY DISAGREE message can also be triggered when the airplane heading differs by more than 30 degrees from the departure runway heading when takeoff power is applied. This portion of the FMC RUNWAY DISAGREE alert functions as intended and provides reliable alerting.

Operating Instructions

Flight crews should be aware of the design limitations of the FMC RUNWAY DISAGREE message. The message may not display for errors in airplane lateral position from the departure runway. If the message is displayed it should be considered valid.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-91 R1 "In Effect" (IE).

This condition is correctd with the installation of AIMS BP05A software. The applicable Boeing service bulletin depends on the AIMS hardware installation:

- AIMS-1 hardware airplanes - SB 777-31-0098.
- AIMS-2 hardware airplanes - SB 777-31-0097.

This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet have the applicable service bulletin incorporated.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
777 Model
Boeing Commercial Airplane Group
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207
USA
Fax: (206) 662-7812
Telex: 32-9430 Station 627
SITA: SEABO7X

Intentionally
Blank



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-92 R2

IssueDate: August 31, 2006

Subject: Fuel temperature blanking indication.

Reason: To inform flight crews of a Fuel Quantity Processor Unit (FQPU) anomaly that may cause blanking of the fuel temperature indication..

Revised to clarify corrective action information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

The fuel temperature indication may blank on certain 777 airplanes, accompanied by the EICAS status message FUEL TEMP INDICATION.

Smiths recently introduced new Fuel Quantity Processor Unit (FQPU) part numbers 0335KPU01 and 0330KPU01 and Boeing incorporated them in production at line positions 423, 429, 466, and 477 and on (refer to Service Letter 777-SL-28-016). The subject problem is associated with the new FQPUs.

Operating Instructions

In the event of inflight blanking of the fuel temperature indication, use Total Air Temperature (TAT) as a conservative indication of fuel temperature.

The FUEL TEMP LOW EICAS advisory message will not display when the fuel temperature indication is blank. Therefore, maintain TAT greater than 3 degrees C above the fuel freeze point.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-92 R2 "In Effect" (IE).

This condition is corrected with FQPU modifications provided in Smiths Aerospace Service Bulletin 0330KPU01-28-0437 or 0335KPU01-28-438, depending on the installed FQPU part number. This bulletin will be cancelled when Boeing is notified all affected airplanes in the customer fleet are modified by appropriate Smiths Aerospace service bulletin.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-93 R2

IssueDate: March 27, 2006

Subject: Incorrect turn direction during a Standard Instrument Departure (SID).

Reason: To inform pilots of a Flight Management Computer System anomaly.

Revised to add service bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

An operator has reported cases of the FMC commanding a turn opposite to that expected and displayed on the map during a SID. Each of the reported occurrences involves a SID with a course reversal shortly after takeoff. In these cases, a right turn was correctly displayed on the map but the FMC commanded a left turn when certain criteria existed. Specifically, when the airplane has a steep initial climb, the airplane may reach an altitude constraint with the airplane in a position to immediately sequence the next leg. For example, many SIDs are coded with an initial "runway heading" leg (VA leg type) that climbs to a specified altitude. In some procedures, the SID also has a "heading to an intercept" leg (VI leg type) with an associated turn direction following the VA leg. When this anomaly occurs, the airplane may reach the specified altitude in a position to immediately sequence the next (VI) leg. Should this simultaneous sequence occur, the VI leg with the turn direction is no longer in the route. Since the turn direction is no longer in the route, the FMC will revert to normal turn logic and command a turn in the shortest direction to the new course. The shortest turn direction may be in the opposite direction from that depicted for the departure. When this anomaly occurs, the map will continue to display the correct magenta path but the airplane may turn in the opposite direction.

The only reported occurrence of this anomaly has been on the RW34 departures at Fukuoka, Japan. However, the software anomaly could cause a similar problem at other airports.

Operating Instructions

During a SID, should the FD or autopilot begin a turn opposite to that displayed on the map or described in the SID description, use HDG SEL or TRK SEL to fly the correct chart course to complete the turn in the correct direction. Following completion of the turn, LNAV may be re-engaged and FD guidance may be followed or the autopilot may be engaged normally.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-93 R2 "In Effect" (IE).

This condition is corrected with the installation of AIMS BP05A software. The applicable Boeing service bulletin depends on the AIMS hardware installation:

- AIMS-1 hardware airplanes - SB 777-31-0098.
- AIMS-2 hardware airplanes - SB 777-31-0097.

This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet have the applicable service bulletin incorporated.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-95 R2

IssueDate: September 25, 2006

Subject: New Ice Shedding Procedures for Airplanes with Trent 800 Engines in Freezing Fog

Reason: To inform flight crews of the need to use special ice shedding procedures in freezing fog conditions.

Revised Background Information and Operating Instructions.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

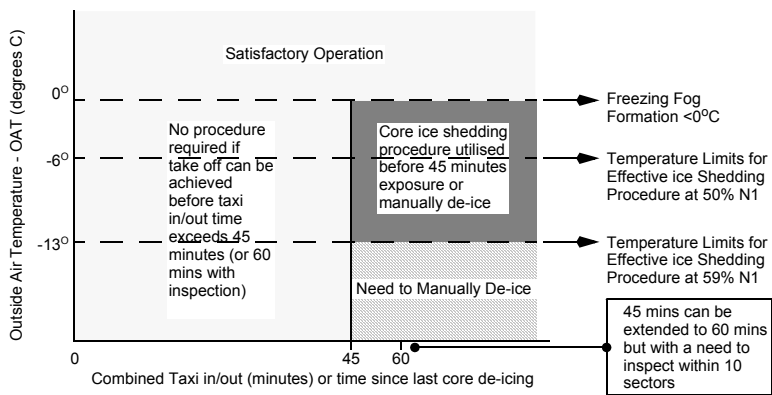
THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received reports of engine surges and internal damage on Trent 700 powered A330 airplanes. This damage was experienced following extended idle thrust operation in freezing fog. In freezing fog conditions, ice can build up in the core of the engine in addition to on the fan. Since the Trent 700 is very similar in design to the Trent 800 on the 777, Boeing and Rolls Royce have determined that a similar situation may occur with the Trent 800. Analysis shows the current Trent 800 ground engine ice shedding procedure, which requires momentary operation at 50% N1 every 60 minutes, is adequate for shedding fan ice accumulations but may not always shed core ice accumulations in freezing fog conditions. Analysis has also shown that extended exposure to freezing fog conditions below -13 degrees C may create ice accumulations that are impractical or impossible to shed using ground run-up procedures. Use of engine anti-ice on the ground will not prevent ice accumulations on the fan or in the core of the engine. An engine which experiences freezing fog on taxi in to the gate will not shed this ice while the engine is shut down in cold temperatures. For this reason, the total time of taxi in and taxi out in freezing fog must be considered.

This procedure is applicable whenever freezing fog with visibility 300 meters or less is reported. This procedure does not apply to operations in snow, hail, sleet, freezing rain, or freezing drizzle. These conditions have a larger water particle size that does not cause core icing. Boeing and Rolls Royce recommend accomplishing the new ice shedding procedure anytime total taxi time exceeds 45 minutes in the above freezing fog/visibility conditions. However, several customers have requested to be able to takeoff after up to 60 minutes of total taxi time without accomplishing the core ice shedding procedure. This is permitted, but the flight crew must make a log book entry of the number of total minutes of taxiing in freezing fog with visibility 300 meters or less. An engine borescope is required within ten flights. In all cases, accomplish the existing Engine Anti-Ice Use Supplementary Procedure prior to brake release for takeoff when the conditions in the procedure are applicable.

The ice shedding procedure in freezing fog conditions is summarized in the following table:



Core Ice Shedding Procedure

Operating Instructions

Flight crews are to use the following core ice shed procedures for Trent 800 engines when freezing fog with visibility 300 meters or less is reported.

If takeoff can be achieved within 45 minutes total taxi time, accomplish the existing Engine Anti-Ice Operation - On the Ground Supplementary Procedures prior to brake release for takeoff. The core ice shed procedure is not required.

If takeoff cannot be achieved within 45 minutes total taxi time, accomplish the following core ice shed procedure within 45 minutes total taxi time to clear the core ice from the engine. Accomplish the following core ice shed procedure at subsequent intervals no greater than every 45 minutes prior to takeoff.

If OAT is 0 degrees C to -6 degrees C, run-up the engines to 50% N1 for 60 seconds every 45 minutes.

If OAT is -7 degrees C to -13 degrees C, run-up the engines to 59% N1 for 60 seconds every 45 minutes.

Note: Setting run-up thrust at 59% N1 is recommended as the Takeoff Configuration Warning may be annunciated at 60% N1.

CAUTION: Precautions must be taken for:

- Jet blast up to 900 feet (300 meters) behind the aircraft.
- Snow and ice at the edge of the taxi way that can be ingested by the engines.
- Slippery taxi surfaces.
- Airport noise restrictions.
- If OAT is less than -13 degrees C, there is no effective run-up procedure and manual de-icing is required.

Regardless of temperature, if the core ice shedding procedure described above is not accomplished within 45 minutes total taxi time in freezing fog, but takeoff can be achieved within 60 minutes total taxi time in freezing fog, takeoff is permitted. A borescope inspection will be required within 10 flights. A note must be made in the log book of this condition.

Take off is not permitted if total taxi time in freezing fog with visibility 300 meters or less exceeds 60 minutes without having accomplished the above core ice shed procedure. The engine core must be manually de-iced.

Note: Crews must include taxi-in time from the previous flight if taxi-in occurred in freezing fog with visibility 300 meters or less and the temperature remains below freezing. The engine may be considered free of ice prior to engine start if:

- manually de-iced,
- visually inspected per the AMM, or
- the above core ice shed run-up procedure is conducted within 5 minutes before engine shutdown during taxi-in.

If the engine is considered free of ice prior to engine start, use only the total taxi-out time.

To avoid manual de-icing requirements, operators are encouraged to work with airport authorities to limit or eliminate exposure to extended taxi times when freezing fog conditions exist.

In all cases, accomplish the Engine Anti-Ice Use Supplementary Procedure, prior to brake release for takeoff when the conditions in the procedure are applicable.

This bulletin has been coordinated with Rolls Royce.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-95 R2 "In Effect" (IE).

This bulletin will be incorporated in a future revision to the 777 FCOM for Trent 800 engines only.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-96 R1

IssueDate: December 10, 2007

Subject: False Engine-Out Indication

Reason: To inform pilots of a Loss of N3 Indication (Dedicated Generator) anomaly on Rolls-Royce engines.

Revised Administration Information section to incorporate corrective service bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Operators have reported in-service events in which the N3 Engine Display arc blanks and the digital N3 displays "0.0." No EICAS alert level messages are present, but several status level messages may result (ENG CONTROL, ENG EEC C1, ENG OPU and ENG TURB OVSP SYS, for example).

This condition is caused by a failure within the engine Dedicated Generator. The Dedicated Generator (DG) is a small generator on the engine gearbox which powers various engine components and provides the N3 signal to the EEC and airplane.

During a recent DG failure, the engine continued to provide normal thrust response. However, the FMC and Autopilot interpreted the N3 signal loss as an engine-out condition. When this condition exists, the Autothrottle may command slow thrust fluctuations to accommodate the false engine-out condition when above approximately FL200. These thrust fluctuations can cause the airspeed to vary between EO Speed and a protective margin below VMO/MMO. At lower altitudes or during climbs and descents at any altitude, autothrottle operation is normal. Additionally, the Autopilot may add a rudder input during LAND 2 / LAND 3 operations. However, because the engines are still operating normally and thrust is symmetrical, the rudder is compensated by aileron input and a slight "cross control" condition may occur when LAND 2 / LAND 3 is annunciated.

FMC performance predictions will approximate the all-engine performance. However, the FMC's CALCULATED fuel value on the PROGRESS 2/x page will lag the TOTALIZER until the FUEL DISAGREE EICAS message (AIMS BLOCK POINT 05) or the FUEL DISAGREE - PROG 2/3 CDU scratchpad message (AIMS BLOCK POINT 03 and earlier) is displayed. Selection of the TOTALIZER will ensure that fuel and ETA predictions reflect the all-engine configuration.

Additionally, the loss of N3 following a DG failure will inhibit an in-flight engine start should the respective engine fail. Crews should be aware that the combined probability of loss of N3 due to a DG failure and an engine failure is extremely remote.

Boeing and Rolls Royce are investigating an improved Dedicated Generator to resolve this issue.

Operating Instructions

If one of the N3 Engine Display arcs blank and the respective digital N3 value displays "0.0," but all other engine indications are normal:

1. Operations above approximately FL200: Climbs and descents are not affected. During cruise, disconnect the autothrottle and set power for the desired speed or Mach.
2. Approach to an Autoland (LAND 2 / LAND 3): The 777 Autopilot has been demonstrated to safely land and rollout with an engine out. Therefore, should an autoland be required and this false engine-out condition exists, continue the approach and landing. Manual landings are not affected.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-96 R1 "In Effect" (IE).

An interim software update to improve the EEC response to this anomaly will be available in December 2005. However, the airplane level effects described in this bulletin will continue until new Dedicated Generator hardware is available.

This bulletin will be cancelled after Boeing is notified that all affected airplanes have been modified by vendor (RR) Service Bulletin RB.211-72-E845.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X

Intentionally
Blank



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-97 R1

IssueDate: June 30, 2006

Subject: Automatic Re-Boot of Electronic Flight Bag (EFB)

Reason: To inform flight crews that the First Officer's EFB system may re-boot when extending or raising the landing gear.

Revised to add Service Bulletin information

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

The BP02 Electronic Flight Bag (EFB) system, has a known anomaly on the First Officer (FO) side installation which causes the entire FO EFB system to automatically re-boot during most gear extension and retraction cycles. This is caused by vibrations from the nose gear retraction and extension. The system normally re-boots successfully (approximately 3 mins), after which the EFB system may be used normally. For this condition, there is no need to record this anomaly in the Airplane Maintenance Log. No known issues have been identified with the Captain's side installations.

Operating Instructions

If the First Officer EFB system re-boots successfully during landing gear extension or retraction, no crew action is required. If the system does not regain normal operation automatically, an Airplane Maintenance Log entry should be made.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-97 R1 "In Effect" (IE).

This condition is corrected with the installation of Boeing Service Bulletin SB 777-46-0005. This bulletin will be cancelled when all affected airplanes in the customer fleet are modified.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-99

IssueDate: July 11, 2005

Subject: GE90-94B Autostart Logic during High Altitude Ground Starts

Reason: To inform flight crews of the need to monitor, and take possible action, during engine ground autostarts at high altitude airports.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin applies only to aircraft equipped with GE90-94B engines.

A GE90-94B powered 777 operator experienced several hot starts in Mexico City, a high altitude airport. These hot starts were a result of an engine that exceeded its serviceability limits (high cycle engine with high pressure compressor problems) combined with high altitude airport and high ambient temperature. Flight crews reported they manually interrupted the auto start sequence when EGT exceeded the ground start limit of 750 degrees C. In one case, EGT reached 770 degrees C by the time the flight crew manually aborted the autostart. QAR data revealed that the engine had stalled each time before exceeding the start EGT limit.

EGT in excess of 750 degrees C during an engine start is abnormal, regardless of cause, and must be investigated prior to flight. Normally, in case of a hot start, the autostart logic stops fuel to the engine if/when EGT exceeds 740 degrees C, so it automatically protects against exceedences of the 750 degrees C Start Redline limit. Therefore, the Engine Start procedure described in the Operations Manual does not require crew action during autostart (except for low oil pressure).

However, in the high-altitude conditions of the reported incidents, the autostart logic did not protect the start EGT limit. Analysis confirmed that at high airport altitudes the EEC logic may turn off the autostart EGT protection features prior to reaching idle. In these circumstances, the normal sub-idle stall logic will still protect against exceedances of 800 degrees C, but the control will not automatically protect against exceedance of the 750 deg C start EGT limit.

A future version of EEC software will contain logic changes to ensure that, for all conditions, the autostart EGT protection features remain active until the start is complete. Prior to the availability of this software, flight crews should monitor EGT during autostarts, and manually abort the start if EGT exceeds the Start Redline limit.

Operating Instructions

The flight crew should monitor EGT during an autostart with GE90-94B engines, and manually abort the start for any EGT exceedence of 750 degrees C or when EGT is observed rapidly approaching 750 degrees C.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-99 "In Effect" (IE).

This condition is temporary until the system is modified. This bulletin will be revised to include Service Bulletin information when available.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-100 R1

IssueDate: January 9, 2006

Subject: Flight Control Anomaly

Reason: To inform flight crews of a pitch up anomaly during climb.
Revised Administrative Information to include additional Service
Bulletin Information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

A 777-200ER recently experienced a significant nose-up pitch event while climbing through FL360. The event was accompanied by: indication, warning, autopilot, autothrottle, and flight control anomalies. The flight crew disconnected the autopilot and autothrottle and stabilized the airplane using nose down control column force, during which time the airplane climbed above 41000 feet, decelerated to a minimum airspeed of 158 knots and activated the stick shaker.

During this flight, the flight crew observed the following anomalies:

- Airspeed indicator amber band displayed up to the MMO limit.
- Airspeed indicator trend vector displaying much greater than actual acceleration.
- Slip-skid indicator showing incorrect full scale deflection.
- Undesired autothrottle re-engagement due to high amber band indication.
- Control forces initially exceeding approximately 30 pounds, decreasing gradually to normal levels.
- Windshear warning.
- Position trend vector displaying an incorrect sharp turn on the navigation display.

- Erratic autobrake activity.

The flight returned safely to the origin airport. This is the first 777 airplane that has experienced this type of event. Investigations by Boeing and Honeywell have revealed the primary cause of the event to be a false acceleration signal from the ADIRU which caused both the autopilot (while engaged) and the primary flight control system to increase the airplane pitch attitude in response to the false acceleration signal. The SAARU, which was operating normally on the incident airplane, provided inputs to the flight control system that significantly reduced the severity of the event. Until corrective action is complete, crews should be aware of the following in the unlikely event this anomaly should reoccur:

- The airplane may pitch up or down depending on the nature of the false ADIRU signal.
- Pitch attitude can be controlled with enough force on the control column.
- The control forces will begin to decrease within approximately 10 seconds then gradually, over a period of approximately two minutes, decrease to near normal.
- The autothrottle may automatically re-engage if current speed is below the top of the amber band.
- The autopilot and flight director may provide erroneous guidance and control.
- Primary airspeed, altitude, vertical speed and attitude indications remain accurate.
- DIRECT control laws are not affected.

Boeing and Honeywell are aggressively developing an ADIRU software fix in coordination with the NTSB and the FAA.

Boeing is recommending operators not permit SAARU-inoperative dispatch until the ADIRU software fix is incorporated.

Operating Instructions

In the event that an airplane upset should occur, flight crews are advised to cross-check all available flight instruments and follow the published Upset Recovery procedure. If the upset is accompanied by the indications described above, flight crews should take the following additional actions if recovery is not immediate:

Apply as much control force as needed to establish a normal pitch attitude, to include both pilots pushing or pulling together. Although initial manual control forces may be high, the affects of the ADIRU anomaly on manual control forces are expected to diminish within 10 seconds and should be back to near normal within 2 minutes.

If undesired autothrottle behavior occurs:

A/T Arm switches ----- OFF

Do not attempt to re-engage the autopilot or autothrottle.

If recovery is not progressing satisfactorily:

PFC Disconnect Switch ----- DISCONNECT

Continue with the Upset Recovery procedure.

Plan to land at the nearest suitable airport.

Do not use Autobrakes for landing.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-100 R1 "In Effect" (IE).

This condition is temporary until the system is modified. This bulletin will be cancelled when Boeing alert service bulletin SB 777-34A0137 is incorporated.

While incorporation of SB 777-34A0137 corrects the anomaly associated with this bulletin, it also causes the anomalies associated with two previous bulletins "ADIRU Heading Error Anomaly" and "Incorrect Display of Drift Angle" to apply again. If SB 777-34A0137 has not been incorporated, it is recommended that SB 777-34A0138 be incorporated instead to correct the anomalies associated with all three bulletins. This bulletin, however, will be cancelled when Boeing is notified that either SB 777-34A0137 or SB 777-34A1038 is incorporated in the customer fleet.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X

Intentionally
Blank



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-101 R1

IssueDate: June 14, 2010

Subject: FMC Performance Predictions Anomaly

Reason: To inform flight crews of an FMC performance prediction anomaly following ABEAM PTS selection.

Revised to add service bulletin information

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Operators have reported erroneous FMC performance predictions following execution of the ABEAM PTS function on the LEGS page. When OAT values have been previously entered in LSK 5R on the WIND page, and the ABEAM PTS feature is then selected following a "direct-to" flight plan modification, the OAT value on the WIND page erroneously changes to "0" degrees. Subsequently, the fuel predictions are erroneously calculated based upon 0 degrees instead of the previously entered value for the respective cruise altitude. Operators have reported display of INSUFFICIENT FUEL FMC alert messages and fuel predictions much lower than planned. Additionally, there are no flight deck annunciations or alerts to the crew to indicate the OAT value on the WIND page has changed.

Operating Instructions

Following selection of the ABEAM PTS feature, review the ALT/OAT value on the respective WIND page. Re-enter the correct altitude and the indicated SAT (from PROGRESS page 2) on the ALT/OAT line for the next waypoint, if required. This data will propagate to all down track waypoints. Following reentry of OAT, FMC fuel predictions should be near those on the flight plan.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-101 R1 "In Effect" (IE).

This condition exists on airplanes that do not have AIMS BPV14 software installed. This condition is corrected with the installation of AIMS BPV14 software. The applicable Boeing service bulletin depends on the AIMS hardware installation:

- AIMS-1 hardware airplanes - SB 777-31A0179.
- AIMS-2 hardware airplanes - SB 777-31A0150.

This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet have the applicable service bulletin(s) incorporated.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
 777 Model
 Boeing Commercial Airplane Group
 P.O. Box 3707 M/C 20-89
 Seattle, WA 98124-2207
 USA
Fax: (206) 662-7812
Telex: 32-9430 Station 627
SITA: SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-102 R2

IssueDate: January 9, 2006

Subject: Fuel Quantity Blanking on the Progress 2/3 Page of the Control Display Unit (CDU)

Reason: To inform flight crews of an FMC fuel blanking anomaly.

Revised Background and Administrative Information, revised Note in Operating Instructions, added Service Bulletin information.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Operators have reported no fuel quantity display on the Progress Page 2/3 during preflight checks. This can occur when the Fuel Quantity Processor Unit (FQPU) operates in Reversionary Mode. The FQIS still provides fuel quantity on Primary EICAS and the Fuel Synoptic but fuel quantity data is not displayed on the CDU for TOTALIZER and CALCULATED fuel quantity. All fuel quantity displays on primary EICAS and the fuel synoptic will be unaffected. Once the FQPU begins operating in reversionary mode, it will stay in this condition until FQPU power is cycled. If the FQPU begins operating in reversionary mode after engine start, only the TOTALIZER fuel quantity display will blank on the Progress Page 2/3 and the CALCULATED fuel quantity display will be unaffected.

Operating Instructions

If the TOTALIZER and CALCULATED fuel quantity displays are blank on the Progress 2/3 page of the CDU on the ground prior to engine start, and a box prompt exists below the Fuel header on the Perf Init page of the CDU, and the indicated fuel quantity on EICAS shows the correct quantity compared to airplane loading information, then flight crews should accomplish the following:

- Manually enter the fuel quantity from EICAS on the PERF INIT page of the CDU. MANUAL will be displayed next to the entered fuel quantity.
- Verify the fuel quantity entered above is displayed under the CALCULATED fuel quantity display on the Progress Page 2/3.

The FMC will now provide accurate fuel predictions. Once entered, the MANUAL fuel quantity cannot be deleted on the Perf Init page, Automatic jettison capability to a selected quantity remaining is inoperative. The flight crew must monitor the fuel quantity during jettison and terminate jettison manually by selecting the jettison nozzle switches OFF. The TOTALIZER display will remain blank on the Progress Page 2/3, and the FUEL DISAGREE message will be inhibited.

Note: The absence of a box prompt on the Perf Init page during the condition identified in this bulletin indicates a separate problem with the engine fuel flow meter system. This condition must be investigated by maintenance.

If jettison is required during this condition, the following procedure applies:

Fuel Jettison Arm Switch ----- ARMED

Note: The FUEL AUTO JETTISON message will display on EICAS.

Determine the fuel quantity to remain after jettison.

The crew can calculate the jettison time from the total fuel quantity using the jettison rates of 5400 lbs / 2500 kgs per minute with fuel in the center tank, or 3100 lbs / 1400 kgs per minute with center tank empty.

Note: VNAV is not available during jettison due to no fuel quantity being available - CALC fuel and TOTALIZER fuel already will not display in the FMC due to this condition.

Fuel Jettison Nozzle Switches (both) ----- ON

When the desired remaining fuel is reached:

Fuel Jettison Nozzle Switches (both) ----- OFF

(continued)

Fuel Jettison Arm Switch----- OFF

Wait five minutes after fuel jettison arm switch was positioned OFF

[Manual entry of fuel quantity is not possible until 5 minutes after jettison is complete.]

Enter final post-jettison fuel quantity into the box prompt on the Perf Init page to re-initialize the CALCULATED fuel quantity display and enable VNAV to function again.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-102 R2 "In Effect" (IE).

This condition will be corrected with new FQPU software expected to be released in May 2006. The FQPU software will be installed by Boeing Service Bulletin 777-28-0048. This operations manual bulletin will be cancelled when Boeing is notified that SB 777-28-0048 is installed on all airplanes in the customer fleet.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X

Intentionally
Blank



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-103

IssueDate: February 3, 2006

Subject: Fuel Flow Blanking with GE90-100 Series Engines

Reason: To inform flight crews of fuel flow blanking at minimum idle during descent.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Note: This bulletin applies to 777 airplanes equipped with GE90-100 series engines only.

Boeing has received reports of fuel flow indications blanking on GE90-100 series engines at or near minimum idle during descent. If the fuel flow display returns to normal at thrust levels above minimum idle, these blanking events can be considered a nuisance fault. Blanking at thrust levels at or above approach idle should be considered a valid fault which requires maintenance action and/or MEL relief.

Operating Instructions

No flight crew action is required, provided the fuel flow indication blanking occurs only at or near minimum idle thrust.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-103 "In Effect" (IE).

This condition is temporary until the system is modified. This bulletin will be cancelled when GE service bulletins GE90-100 SB 73-0025 and GE90-100 SB 73-0026 are incorporated.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
777 Model
Boeing Commercial Airplane Group
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207
USA

Fax: (206) 662-7812
Telex: 32-9430 Station 627
SITA: SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-104

IssueDate: September 29, 2006

Subject: Generator OFF Light ON After Engine Start With No EICAS Message

Reason: To inform flight crews of potential generator off line with no alert message.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

In normal operation, if a main generator drops off line for any reason, the associated generator OFF light illuminates, and an EICAS Advisory message ELEC GEN OFF L, R is shown.

During an engine start if a generator does not reach a minimum frequency of 380 Hz the generator will not come on line and the generator OFF light will remain illuminated. However, the ELEC GEN OFF L, R EICAS message may not show. This lack of an EICAS message is known to have occurred on two or more occasions during engine starts only.

The Generator Control Unit supplier, Hamilton Sundstrand, is studying the feasibility of incorporating a change which will assure the ELEC GEN OFF L, R message is displayed on EICAS if the generator fails to come on line during engine start.

Operating Instructions

After engine start, flight crews should check that the generator OFF lights on the electrical panel are not illuminated. If a generator OFF light is illuminated, maintenance action is required.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-104 "In Effect" (IE).

This condition is temporary until the system is modified. This bulletin will be revised when service bulletin information is available.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-105 R2

IssueDate: June 14, 2010

Subject: Incorrect TAKEOFF REF data following a TAKEOFF REF Uplink.

Reason: To inform pilots of an FMC Takeoff Datalink anomaly.

Revised to update service bulletin information

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

An operator reported events where old TAKEOFF REF page data (THRUST, RW, Vspeeds, etc.) appeared on the TAKEOFF REF page 1 following an updated TAKEOFF REF uplink just prior to takeoff. In each event, the flight crew reported that the incorrect data appeared to be from the previous leg. Boeing has replicated the behavior and discovered a software anomaly that allows old TAKEOFF REF uplinks to remain in memory between flights. When this anomaly occurs, the old data appears on the TAKEOFF REF page following a TAKEOFF REF uplink that contains only partial takeoff data (CG for example).

Operating Instructions

Do not accept partial TAKEOFF REF page uplinks (only an updated GC, for example) unless you have previously received and accepted a complete TAKEOFF REF page (all data fields contain data) for the intended flight leg. If a partial uplink is received and any fields on the TAKEOFF REF page are blank, dashes, or boxes, reject the uplink and select the REQUEST prompt on the TAKEOFF REF page to get a complete TAKEOFF REF uplink or enter the TAKEOFF REF data manually.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-105 R2 "In Effect" (IE).

This condition is corrected with the installation of AIMS BPV14 software. The applicable Boeing service bulletin depends on the AIMS hardware installation:

- AIMS-1 hardware airplanes - SB 777-31A0179.
- AIMS-2 hardware airplanes - SB 777-31A0150.

This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet have the applicable service bulletin(s) incorporated.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
777 Model
Boeing Commercial Airplane Group
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207
USA

Fax: (206) 662-7812

Telex: 32-9430 Station 627

SITA: SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-107 R2

IssueDate: June 14, 2010

Subject: FMC Minimum V1, VR, V2 Speed Entry Limits for 777-200LR and 777-300ER Models

Reason: To inform flight crews of reduced FMC capability to detect erroneous manual and uplinked V1, VR and V2 entries.

Revised to update service bulletin information

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This condition exists only on the 777-200LR and 777-300ER airplanes.

An AIMS OPC option is enabled for all 777-200LR and 777-300ER models which results in the deactivation of minimum value checking for uplinked or manually entered V1, VR and V2 speeds. Flight crews are advised that the FMC will accept uplinked or manually entered V-speeds as low as 80 knots. "MINV1", "MINVR", and "MINV2" do not display in the associated header lines, and the value of MINV1, MINVR, and MINV2 do not display in the data lines on the TAKEOFF REF page.

Operating Instructions

Flight crews should ensure that manually entered V speeds are entered correctly on the TAKEOFF REF page of the CDU.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-107 R2 "In Effect" (IE).

This condition exists in 777-200LR and 777-300ER airplanes that do not have AIMS BPV14 software installed. This condition is corrected with the installation of AIMS BPV14 software. The applicable Boeing service bulletin depends on the AIMS hardware installation:

- AIMS-1 hardware airplanes - SB 777-31A0179.
- AIMS-2 hardware airplanes - SB 777-31A0150.

This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet have the applicable service bulletin(s) incorporated.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address: Manager, Flight Training and Technical Data
 777 Model
 Boeing Commercial Airplane Group
 P.O. Box 3707 M/C 20-89
 Seattle, WA 98124-2207
 USA
Fax: (206) 662-7812
Telex: 32-9430 Station 627
SITA: SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-108 R2

IssueDate: June 14, 2010

Subject: Honeywell Flight Management Computer Anomaly

Reason: To inform flight crews of a Honeywell FMC anomaly that incorrectly deletes a speed constraint. Revised to reflect AT-OR-BELOW is not a factor in this anomaly.

Revised to add service bulletin information

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has confirmed operator reports of a Honeywell FMC anomaly that incorrectly deletes a speed constraint. Some SIDs are designed to limit turn radius to maintain clearance with other traffic or restricted airspace. Some of these procedures also have an AT-OR-ABOVE altitude restriction in conjunction with the speed constraint. Typically, the airplane will be required to limit speed until passing the respective waypoint as well as climb above the altitude constraint. In these procedures, VNAV will incorrectly delete the speed constraint prior to reaching the waypoint if the altitude constraint has been satisfied. When this happens, VNAV will command speed to accelerate to ECON speed (or SEL speed) prior to reaching the constrained waypoint. This anomaly exists on all Boeing 747 / 757 / 767 / 777 airplanes equipped with the Honeywell FMC.

Honeywell is aware of this anomaly and has planned changes for the 777.

Operating Instructions

To prevent exceeding a speed restriction when accompanied by an AT-OR-ABOVE altitude constraint, use speed intervention (enter speed constraint in the MCP Speed Window) until the constrained waypoint is sequenced. After passing the waypoint, select VNAV as desired.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-108 R2 "In Effect" (IE).

This condition exists on airplanes that do not have AIMS BPV14 software installed. This condition is corrected with the installation of AIMS BPV14 software. The applicable Boeing service bulletin depends on the AIMS hardware installation:

- AIMS-1 hardware airplanes - SB 777-31A0179.
- AIMS-2 hardware airplanes - SB 777-31A0150.

This bulletin will be cancelled when Boeing is notified that all affected airplanes in the customer fleet have the applicable service bulletin(s) incorporated.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-111 R3

IssueDate: December 14, 2009

Subject: Cold Fuel Operations Procedures for RR Trent 800 Series Equipped 777 Airplanes

Reason: To inform flight crews of new procedures to prevent, or address, the loss of thrust response or thrust rollback when operating with cold fuel.

As the result of a recent thrust rollback incident on a second RR Trent 800-powered 777-200ER, revision 2 of this bulletin revises the condition statement on the Engine Response non-normal checklist and also revises the Cold Fuel Operations supplementary procedure. In addition, the Background Information and Operating Instructions of the bulletin have been updated.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Investigations into an accident involving a RR Trent 800-powered 777-200ER and a subsequent thrust rollback incident involving another RR Trent 800-powered 777-200ER have identified the potential for a restriction in fuel flow under certain conditions, resulting in thrust rollback and failure to achieve a commanded thrust. The restriction can be caused by ice building up within the fuel supply system, then breaking free and collecting downstream at the engine Fuel Oil Heat Exchanger (FOHE). It must be emphasized that the investigations are still on-going, but knowledge gained to date has led to the development of procedures to address this potential condition.

Water is present in jet fuel and is uploaded into the aircraft during each refueling. The airplane's water scavenge system and periodic sumping can prevent excessive water build-up within the tanks. However, these measures cannot remove all water present in the tanks. Since water is always present in jet fuel, ice will form as the fuel temperature cools below 0 degrees C. The unusual circumstances of the accident flight include burning from the main wing tanks for an extremely long period of time at low fuel temperatures and at lower than average fuel flows, stretching back into the previous flight, with the fuel temperature remaining below 0 degrees C after fueling.

During the accident flight, the fuel temperature reached a low of -34 degrees C during cruise, and warmed to only -22 degrees C on approach, both of which are unusually cold for the 777 fleet. Step climbs were conducted using lower power settings for passenger comfort. Laboratory testing has shown that ice can accumulate within the tank and fuel system at cruise power settings. Over many hours at low power settings, it is believed that ice accumulation can reach a significant amount. Periodic high fuel flows, such as used in VNAV step climbs, help keep the system clear of large amounts of ice.

Laboratory testing has shown that the FOHE will effectively melt typical amounts of ice that travel downstream from the fuel supply system. If too much ice arrives at one time, a partial blockage can occur. The amount of restriction will vary depending on the amount of ice, but the fuel flow always remains higher than idle and engine flameout will not occur. Depending upon the amount of ice, the restriction may go away on its own.

However, laboratory testing has also shown that reducing the fuel flow to min idle fuel flow will always clear any amount of ice at the FOHE within a few seconds. This reduction in fuel flow reduces the amount of cold fuel entering the FOHE, allowing the hot oil to quickly melt the ice. Full thrust capability is then completely restored. Testing has also shown that the FOHE is not susceptible to ice restriction if the fuel temperature is -10 degrees C or warmer.

During the subsequent thrust rollback incident, the thrust rolled back to a level above idle on only one engine during level cruise flight at FL 390, approximately 40 minutes after a VNAV step climb. The indicated EPR dropped below the commanded level, causing a large command EPR sector to appear on the EPR indicator of the affected engine. The flight crew performed the Engine Response non-normal checklist, which cleared the restriction and restored full capability to the engine for the remainder of the flight. The other engine operated normally throughout the flight.

Reviewing over 1.2 million flights of this airplane model/engine type did not reveal any other instance where the thrust rolled back during cruise or after a step climb in this manner.

Data from the flight data recorder of the thrust rollback aircraft shows that two VNAV step climbs occurred, one 55 minutes prior to the rollback and another one 15 minutes later (40 minutes before the rollback). It is suspected that ice was released within the fuel system during the first step climb, traveled downstream and formed a restriction at the face of the FOHE of the affected engine. While the restriction was not large enough to cause an immediate rollback, the oil temperature rose uncharacteristically on that engine. The second step climb was successfully completed in this condition 15 minutes later, 40 minutes before the restriction caused the thrust to roll back.

The flight profile of the thrust rollback aircraft was quite different from the flight profile of the accident aircraft. While the flight of the thrust rollback aircraft was long range and colder than average, it was not as cold as that experienced with the accident aircraft. The fuel temperature encountered by the thrust rollback aircraft was not exceptionally low, reaching a minimum of -22 deg. C, which occurred during cruise around the time of the rollback. In addition, the fuel temperature at takeoff was above 0 deg. C, precluding the need to accomplish the fuel recirculation procedure. Also, the step climbs of the two aircraft were performed differently. The step climbs of the thrust rollback aircraft were performed using VNAV while the accident aircraft step climbs were performed at lower thrust settings for passenger comfort.

Operating Instructions

The circumstances that differentiate the accident flight from millions of other flights led to the previously attached (but now incorporated) conservative Cold Fuel Operations supplementary procedure and the Engine Response non-normal checklist. The goal of these procedures is to assure continued safe operation of RR Trent 800-powered 777s by preventing a long term accumulation of ice beyond the level manageable by the FOHE.

The circumstances of the thrust rollback flight has caused the Cold Fuel Operations supplementary procedure and the Engine Response non-normal procedure to be revised (see attachments). The attached Cold Fuel Operations supplementary procedure should now be accomplished within 2 hours (revised from 3 hours) of top of descent when fuel temperature is colder than -10 degrees C; and the Engine Response non-normal procedure (non-normal checklist) should be accomplished if the engine(s) did not reach commanded thrust or rolls back, and fuel system icing is suspected (indicated EPR is below commanded EPR and fuel temp is below -10 degrees C).

Perform all step climbs using VNAV or maximum climb thrust.

During initial descent, maintain idle thrust for a minimum of 30 seconds.

The appearance of a command EPR sector (when actual EPR is less than commanded EPR), as experienced in the thrust rollback incident, is a symptom that can be used to differentiate between a cold fuel icing rollback from a type of rollback where the command EPR also rolls back with the actual EPR, such as occurs with P20 probe icing.

As with the previous release of this bulletin, these revised procedures are not required if fuel temperature is -10 degrees C or warmer.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-111 R3 "Incorporated" (INC).

This bulletin will be incorporated in the June 15, 2009 revision of the Flight Crew Operations Manual. The affected LEP, index and table of contents pages will be updated at that time. This bulletin will be cancelled when Boeing is notified that service bulletin 777-72A0030 has been incorporated into the customer's fleet.

Please send all correspondence regarding Operations Manual Bulletins status to one of the following addresses:

Mailing Address:	Manager, Flight Training and Technical Data 777 Model Boeing Commercial Airplane Group P.O. Box 3707 M/C 20-89 Seattle, WA 98124-2207 USA
Fax:	(206) 662-7812
Telex:	32-9430 Station 627
SITA:	SEABO7X



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-114

IssueDate: December 14, 2009

Subject: FMC Failure When Programming a "step-down" Descent.

Reason: To inform flight crews of an FMC anomaly.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Operators have reported dual FMC failures when a "planned step" to a lower than current cruise altitude is entered and executed on the LEGS page. Frequently, the "planned step down" entry was followed by route changes executed on the RTE page. Boeing has confirmed that when a LEGS page entry such as "/FL230S" is executed, and that altitude is below the current cruise altitude displayed on the ACT CRZ page, both FMCs may momentarily reset to resolve the planned "step down" in the flight plan route.

Operating Instructions

Do not enter a planned step altitude (in the format FLxxxS) that is below the current cruise altitude. When a descent is required to a new cruise altitude, enter a new cruise altitude in line 1L on the CRZ page and perform a cruise descent.

Administrative Information

Insert this bulletin behind the Flight Crew Operations Manual Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TBC-114 "In Effect" (IE).

This anomaly will be corrected in the next AIMS software revision (AIMS updates after BP V14) with FMC update. This bulletin will be revised to incorporate the appropriate service bulletin information that corrects this anomaly at the time that information becomes available.

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status to:

Mailing Address: Boeing Commercial Airplanes
Commercial Aviation Services
Attn: 777 Manager, Flight Technical Data
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207 USA

email: flighttraining@boeing.com
Telephone: (206) 662-4000
Fax: (206) 662-4743



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-115 R1

IssueDate: June 14, 2010

Subject: Uncommanded Autothrottle Movement During Cruise Flight.

Reason: To inform flight crews of an autothrottle anomaly.

Revised to incorporate new operating instructions and to add specific service bulletin information that resolves the anomaly when incorporated.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Operators have reported several instances of uncommanded autothrottle movement during the cruise phase of flight. Reports indicate that the autothrottle advanced the thrust levers to full climb thrust even though the speed of the airplane was at the desired speed. While the thrust levers were moving forward, the EICAS message FUEL TEMP LOW appeared for approximately 2 seconds in most of the reported cases. On each event, the thrust levers returned to normal with no action by the flight crew.

This condition was reported to happen multiple times during the same flight, each event lasting for approximately 3-10 seconds.

When investigating this condition, it was determined that a very short term data corruption between the two AIMS cabinets is the cause of the anomaly. Boeing and Honeywell plan to modify the AIMS OPS to resolve this condition and the condition of the display of the erroneous FUEL TEMP LOW advisory EICAS message.

Operating Instructions

To prevent the above described anomaly from occurring, before performing any preflight procedures, move the FMC selector switch to either L or R, then back to AUTO. Should cycling of the FMC selector switch be inadvertently overlooked prior to preflight, cycling of the switch inflight at any time will resolve or prevent the anomaly.

Administrative Information

Insert this bulletin behind the Flight Crew Operations Manual Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TBC-115 R1 "In Effect" (IE).

The condition of uncommanded autothrottle movement of the thrust levers is corrected with an AIMS upgrade. The AIMS upgrade version and associated service bulletin is dependant on the AIMS hardware installation:

- AIMS-1 hardware airplanes - BP V14 - SB 777-31A0179
- AIMS-2 hardware airplanes - BP V15 - SB 777-31-0167

The erroneous FUEL TEMP LOW advisory EICAS anomaly will be corrected in a succeeding AIMS OPS release.

This bulletin will be cancelled when Boeing is notified that all affected airplanes in a customer's fleet have the applicable service bulletin(s) incorporated.

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status to:

Mailing Address: Boeing Commercial Airplanes
Commercial Aviation Services
Attn: 777 Manager, Flight Technical Data
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207 USA

email: flighttraining@boeing.com
Telephone: (206) 662-4000
Fax: (206) 662-4743



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-116

IssueDate: December 21, 2009

Airplane Effectivity: WY260, WY270

Subject: Incorrect Display of Crossbleed (X-BLD) Start Indication for 777-200LR and 777F airplanes.

Reason: To inform flight crews that, when an engine is shut down in flight, the crossbleed start indication is not showing correctly.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This condition exists only on 777-200LR and 777F airplanes.

When an engine is shut down in flight, the in-flight start envelope is shown on EICAS for the current flight level or the maximum flight level, whichever is less. The lowest airspeed for an in-flight windmill start is 270 knots. If the current airspeed is below 270 knots, X-BLD is displayed above the N2 display.

However, a software anomaly causes the X-BLD indication to be incorrectly removed at speeds greater than 260 knots, rather than 270 knots. Even though the X-BLD indication has been incorrectly removed, if the current airspeed is below 270 knots, a crossbleed start should be done. If the current airspeed is 270 knots or above, a windmill start should be done.

Operating Instructions

When operating 777-200LR and 777F airplanes, use the attached, revised ENG FAIL L, R; ENG IN-FLIGHT START L, R; ENG START VALVE L, R non-normal checklists as appropriate.

Operations Manual Information

Replace the affected pages in section 7 (Engines, APU) of the QRH with the associated attached pages. These pages may be reissued in the June 14, 2010 revision, at which time the EICAS Messages Index, Alphabetical Index and LEP will also be updated.

Administrative Information

Insert this bulletin page behind the Flight Crew Operations Manual Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TBC-116 as "In Effect" (IE) .

This anomaly will be corrected in a future AIMS software revision. This bulletin will be cancelled when the appropriate service bulletin that corrects the anomaly has been incorporated into the fleet.

This bulletin will be revised when corrective service bulletin information becomes available.

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status to:

Mailing Address: Boeing Commercial Airplanes
 Commercial Aviation Services
 Attn: 777 Manager, Flight Technical Data
 P.O. Box 3707 M/C 20-89
 Seattle, WA 98124-2207 USA

email: flighttraining@boeing.com
Telephone: (206) 662-4000
Fax: (206) 662-4743



Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207



Number: TBC-117

IssueDate: January 20, 2010

Subject: Loss of VHF Datalink Function on the Primary VHF Data Radio

Reason: To advise flight crews of a condition where the primary VHF Data Radio loses DATA mode and latches into voice mode.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

A condition has been identified where the VHF datalink function can be lost on the primary VHF Data Radio (VDR). When this condition occurs, the primary VDR latches into voice mode, and DATA cannot be transferred from the STANDBY window to the ACTIVE window of the primary VDR's radio tuning panel. In addition, DATA mode cannot be selected for the primary VDR from the VHF page under the Flight Deck Communication Function (FDCF) MANAGER menu on the MFD.

Also, the EICAS advisory message VHF DATALINK appears, signifying VHF datalink is no longer available. If SATCOM is unavailable and HF datalink is not active, the EICAS advisory message DATALINK SYS appears instead.

This anomaly occurs only on 777 airplanes with AIMS-2 BP V14 and may be caused by a tuning mis-comparison between the Data Communications Management Function (DCMF) and the radio tuning panel, and a software error in the VHF sub-system in the DCMF.

This condition occurs most often during engine start, but also has been seen in other phases of flight.

Operating Instructions

Continue to perform datalink operations normally using SATCOM or HF (if HF datalink is activated) instead of VHF. This requires no pilot action because the DCMF will automatically use SATCOM as a backup air/ground medium as long as it is available. If SATCOM is unavailable and HF datalink is activated and available, the DCMF will use HF for datalink.

Alternately, it is possible to perform VHF datalink with the secondary VDR. This requires the following flight crew actions to switch to the alternate DCMF:

1. Select COMM on the DSP
2. Select MANAGER on the MFD
3. Select ACARS
4. Select PG 2
5. Deselect SATCOM
6. Deselect HF (if present)
7. Select RETURN
8. Select VHF
9. Select DEFAULT RADIO RIGHT (if switching from DCMF L to DCMF R) or DEFAULT RADIO CENTER (if switching from DCMF R to DCMF L)
10. Select DEFAULT RADIO MODE DATA
11. Select MANAGER
12. Select ACARS
13. Select PG 2
14. Reselect SATCOM
15. Reselect HF (if present)
16. Select RETURN

When the condition occurs on the ground, notify maintenance.

Administrative Information

Insert this bulletin behind the Flight Crew Operations Manual Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TBC-117 "In Effect" (IE).

The condition of the primary VDR losing DATA mode and latching into voice mode will be corrected in AIMS upgrade BP V15. This bulletin will be revised to incorporate the specific service bulletin number that installs AIMS BP V15 at the time that information becomes available.

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status to:

Mailing Address: Boeing Commercial Airplanes
Commercial Aviation Services
Attn: 777 Manager, Flight Technical Data
P.O. Box 3707 M/C 20-89
Seattle, WA 98124-2207 USA

email: flighttraining@boeing.com
Telephone: (206) 662-4000
Fax: (206) 662-4743

Intentionally
Blank

Service Bulletin Coverage

Data supporting service bulletins requiring mandatory installation are automatically incorporated in the FCOM. Optional service bulletins are covered in the manual both with and without the service bulletin incorporation configurations.

The dual condition coverage continues until such time that the customer advises the Senior Manager of Flight Training & Technical Data of the status of the airplane modification. Upon notification by the customer, the operations manual is modified to remove unnecessary information.

If the customer has not informed the Senior Manager of Flight Training & Technical Data of the incorporation or rejection of an optional service bulletin within two years of the issue of the last revision to the service bulletin, the manual is automatically modified to reflect the most conservative approach of the service bulletin situation.

When content is affected by a service bulletin, a paragraph heading states the bulletin effectivity for the paragraph. When a condition exists where some airplanes have been modified with and without the service bulletin, additional paragraphs with headings designating the effectivity for each paragraph appear in sequence to provide correct data for the airplanes without the service bulletin incorporated.

Intentionally
Blank

Limitations**Chapter L****Table of Contents****Section 0**

Operating Limitations	L.10
General	L.10.1
Airplane General	L.10.1
Operational Limitations	L.10.1
RVSM Operations	L.10.2
Weight Limitations	L.10.2
Door Mounted Power Assists and Escape Slides	L.10.3
Flight Deck Security Door	L.10.3
Lower Crew Rest Compartment	L.10.4
Air Systems	L.10.4
Cabin Pressurization	L.10.4
Autoflight	L.10.4
Autopilot/Flight Director System	L.10.4
Automatic Landing	L.10.4
Communications	L.10.5
Flight Deck Communications Systems (Datalink)	L.10.5
Engines	L.10.5
Engine Configuration	L.10.5
Engine Limit Display Markings	L.10.6
Engine Oil System	L.10.6
Engine Fuel System	L.10.6
Reverse Thrust	L.10.6
Non-AFM Operational Information	L.10.6
Airplane Structure	L.10.7
Flight Controls	L.10.7
Flight Instruments, Displays	L.10.7
Ground Maneuver Camera System	L.10.7
Electronic Flight Bag (EFB)	L.10.7
Flight Management, Navigation	L.10.7
ADIRU	L.10.7
QFE Selection	L.10.7

Fuel System	L.10.7
Warning Systems	L.10.8
GPWS - Look-Ahead Terrain Alerting	L.10.8
TCAS	L.10.8
Runway Awareness and Advisory System (RAAS)	L.10.8

Limitations
Operating Limitations**Chapter L**
Section 10**General**

This chapter contains Airplane Flight Manual (AFM) limitations and Boeing recommended non-AFM operating limitations. Limitations that are obvious, shown on displays or placards, or incorporated within an operating procedure are not contained in this chapter.

Note: Information referring to airplane options and configuration differences is shown in [brackets]. These items are applicable to the –TBC operations manual only, and do not appear in customer Operations Manuals.

Airplane General**Operational Limitations**

[Takeoff and Landing Tailwind Component - 10 knots basic, 15 knots option
Maximum Takeoff and Landing Altitude - 8,400 feet basic, 9,800 feet option.]

Runway slope	+/- 2%
Maximum Takeoff and Landing Tailwind Component	15 knots
Maximum Demonstrated Takeoff and Landing Crosswind	38 knots
Maximum Operating Altitude	43,100 feet pressure altitude
Maximum Takeoff and Landing Altitude	8,400 feet pressure altitude

Turbulent Air Penetration Speed

The turbulent air penetration speed (in severe turbulence) is defined as: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and above. Maintain a minimum speed of 15 knots above the minimum maneuvering speed at all altitudes when airspeed is below 0.82 Mach.

Non-AFM Operational Information

Do not operate HF radios during refueling operations.

Do not operate the weather radar in a hangar or within 50 feet (15.25 meters) of any personnel or a fuel spill.

Note: The hangar and personnel restrictions do not apply to the weather radar test mode.

RVSM Operations

Non-AFM Operational Information

Prior to takeoff the maximum allowable difference between Captain’s or First Officer’s altitude display and field elevation is 75 feet.

The standby altimeter does not meet altimeter accuracy requirements of RVSM airspace.

Weight Limitations

[Maximum design weights]

[777-200]

Weights	Pounds	Kilograms
Maximum Taxi Weight	547,000	248,115
Maximum Takeoff Weight	545,000	247,208
Maximum Landing Weight	445,000	201,849
Maximum Zero Fuel Weight	420,000	190,509

[777-200ER]

Weights	Pounds	Kilograms
Maximum Taxi Weight	652,000	295,742
Maximum Takeoff Weight	650,000	294,835
Maximum Landing Weight	470,000	213,188
Maximum Zero Fuel Weight	440,000	199,581

[777-200LR]

Weights	Pounds	Kilograms
Maximum Taxi Weight	768,000	348,358
Maximum Takeoff Weight	766,000	347,451
Maximum Landing Weight	492,000	223,167
Maximum Zero Fuel Weight	461,000	209,106

777 Flight Crew Operations Manual[\[777F\]](#)

Weights	Pounds	Kilograms
Maximum Taxi Weight	768,000	348,358
Maximum Takeoff Weight	766,000	347,451
Maximum Landing Weight	575,000	260,815
Maximum Zero Fuel Weight	547,000	248,115

[\[777-300\]](#)

Weights	Pounds	Kilograms
Maximum Taxi Weight	662,000	300,278
Maximum Takeoff Weight	660,000	299,371
Maximum Landing Weight	524,000	237,682
Maximum Zero Fuel Weight	495,000	224,528

[\[777-300ER\]](#)

Weights	Pounds	Kilograms
Maximum Taxi Weight	777,000	352,441
Maximum Takeoff Weight	775,000	351,534
Maximum Landing Weight	554,000	251,290
Maximum Zero Fuel Weight	524,000	237,682

Door Mounted Power Assists and Escape Slides[\[Option – Door Marker ARMED/DISARMED\]](#)

Main door emergency power assists and evacuation slide systems must be armed with the mode select handle in the ARMED position prior to taxi, takeoff and landing whenever passengers are carried.

Flight Deck Security Door[\[Passenger\]](#)

Verify that an operational check of the Flight Deck Access System has been accomplished according to approved procedures once each flight day.

Lower Crew Rest Compartment

[Option]

The lower crew rest compartment may not be occupied, and the main entry hatch must be closed during taxi, takeoff, or landing.

Air Systems

Cabin Pressurization

Maximum differential pressure (relief valves)	9.1 psi
Maximum allowable cabin pressure differential for takeoff and landing	0.11 psi

Autoflight

Autopilot/Flight Director System

[Option - Passenger airplanes with high altitude takeoff/landing capability]

Do not use the autopilot below 100 feet RA at airport pressure altitudes above 8,400 feet.

The autopilot must not be engaged below a minimum engage altitude of 200 feet AGL after takeoff.

The autopilot must be disengaged before the airplane descends more than 50 feet below the MDA unless it is coupled to an ILS glideslope and localizer or in the go-around mode.

Without LAND 2 or LAND 3 annunciated, the autopilot must be disengaged below 200 feet AGL.

Automatic Landing

When landing weather minima are predicated on autoland operations the following limits apply:

[Autoland tailwind limitation - 10 knots basic, 15 knots option]

Maximum Allowable Wind Speeds	
Headwind	25 knots
Tailwind	15 knots
Crosswind	25 knots

The maximum glideslope angle is 3.25 degrees.

The minimum glideslope angle is 2.5 degrees.

Automatic landings can be made using flaps 20 or 30, with both engines operative or one engine inoperative. The autopilot flight director system (AFDS) autoland status annunciation must display LAND 2 or LAND 3.

Communications

Flight Deck Communications Systems (Datalink)

The datalink from the COMPANY format is limited to the transmission and receipt of messages, which will not create an unsafe condition if the message is improperly received, such as the following conditions:

- the message or parts of the message are delayed or not received,
- the message is delivered to the wrong recipient, or
- the message content may be frequently corrupted.

However, Pre-Departure Clearance, Digital Automatic Terminal Information Service, Oceanic Clearances, Weight & Balance, and Takeoff Data messages can be transmitted and received via the COMPANY format if they are verified per approved operational procedures.

Engines

Engine Configuration

[\[Representative engines for each model variant\]](#)

777-200

Pratt & Whitney Model PW 4074 or 4077

General Electric Model GE90-76B

Rolls Royce Model Trent 875 or 877

777-200ER

Pratt & Whitney Model PW4090

General Electric Model GE90-85B, -90B or -94B

Rolls Royce Model Trent 884, 892 or 895

777-200LR

General Electric Model GE90-110B1

777-300

Pratt & Whitney Model PW4090 or 4098

Rolls Royce Model Trent 884 or 892

777-300ER and 777F

General Electric Model GE90-115B

Engine Limit Display Markings

Maximum and minimum limits are red.

Caution limits are amber.

Engine Oil System

[PW Engines]

Oil temperature must be greater than 50 degrees C before advancing thrust levers to takeoff power.

[RR Engines]

Oil temperature must be greater than -40 degrees C for engine start and 50 degrees C before advancing thrust levers to takeoff power.

Engine Fuel System

The maximum tank fuel temperature is 49 degrees C.

After refueling and prior to takeoff, if fuel temperature is 0 degrees C or colder or if fuel temperature indication is inoperative, verify the approved fuel circulation procedure was performed.

Tank fuel temperature prior to takeoff must not be less than -40 degrees C or 3 degrees C above the fuel freezing point, whichever is higher. In-flight tank fuel temperature must be maintained at least 3 degrees C above the freezing point of the fuel being used. The use of Fuel System Icing Inhibitor additives does not change the minimum fuel tank temperature limit.

Reverse Thrust

Intentional selection of reverse thrust in flight is prohibited.

Backing the airplane with use of reverse thrust is prohibited.

Non-AFM Operational Information

[GE90-115B or -110B engines]

For ground operation (exclusive of takeoff) in tailwinds and crosswinds between 30 and 45 knots, engine power should be limited to a maximum of 70% N1. Avoid thrust levels above that required for normal taxi operation in all tailwinds and crosswinds greater than 45 knots.

Airplane Structure

Flight Controls

Avoid rapid and large alternating control inputs, especially in combination with large changes in pitch, roll, or yaw (e.g. large side slip angles) as they may result in structural failure at any speed, including below V_A .

Flight Instruments, Displays

Ground Maneuver Camera System

[777-300 and 777-300ER]

The ground maneuver cameras should not be used during takeoff, approach, and landing.

Electronic Flight Bag (EFB)

[Option]

The EFB portable keyboard and attaching cable must be stowed during takeoff and landing.

Flight Management, Navigation

ADIRU

ADIRU alignment must not be attempted at latitudes greater than 78 degrees, 14.75 minutes.

QFE Selection

A QFE altitude reference for the primary flight displays must be selected in the flight management system whenever QFE is used instead of QNH.

Fuel System

Main tanks must be scheduled to be full if center tank fuel is loaded.

[Basic – English Units]

Note: The center tank may contain up to 3000 pounds of fuel with less than full main tanks provided center tank fuel weight plus actual zero fuel weight does not exceed the maximum zero fuel weight, and center of gravity limits are observed.

[Option – Metric Units]

Note: The center tank may contain up to 1360 kilograms of fuel with less than full main tanks provided center tank fuel weight plus actual zero fuel weight does not exceed the maximum zero fuel weight, and center of gravity limits are observed.

Warning Systems

GPWS - Look-Ahead Terrain Alerting

[Enhanced Ground Proximity Warning System with geometric altimetry. Geometric altimetry in the -212 EGPWC permits use of look-ahead terrain alerting during QFE operations]

Do not use the terrain display for navigation.

The use of look-ahead terrain alerting and terrain display functions is prohibited within 15 NM of takeoff, approach or landing at an airport or runway not contained in the GPWS terrain database. Refer to Honeywell Document 060-4267-000 for airports and runways contained in the installed GPWS database.

TCAS

Pilots are authorized to deviate from their current ATC clearance to the extent necessary to comply with a TCAS II resolution advisory.

Runway Awareness and Advisory System (RAAS)

[Option – with Runway Awareness and Advisory System]

Non-AFM Operational Information

Do not use RAAS voice annunciations or alerts for navigation.

Do not use RAAS voice annunciations or alerts as a substitute for NOTAM or ATIS information.

Normal Procedures**Chapter NP****Table of Contents****Section 0**

Introduction	NP.11
General	NP.11.1
Normal Procedures Philosophy and Assumptions	NP.11.1
Configuration Check	NP.11.1
Crew Duties	NP.11.2
Control Display Unit (CDU) Procedures	NP.11.3
Autopilot Flight Director System (AFDS) Procedures	NP.11.3
Preflight and Postflight Scan Flow	NP.11.4
Areas of Responsibility - Captain as Pilot Flying or Taxiing	NP.11.6
Areas of Responsibility - First Officer as Pilot Flying or Taxiing	NP.11.7
Amplified Procedures.....	NP.21
Preliminary Preflight Procedure – Captain or First Officer	NP.21.1
CDU Preflight Procedure - Captain and First Officer	NP.21.3
Exterior Inspection	NP.21.6
Preflight Procedure – First Officer	NP.21.12
Preflight Procedure – Captain	NP.21.24
Before Start Procedure	NP.21.28
Pushback or Towing Procedure	NP.21.31
Engine Start Procedure	NP.21.32
Before Taxi Procedure	NP.21.33
Before Takeoff Procedure	NP.21.35
Takeoff Procedure	NP.21.37
Takeoff Flap Retraction Speed Schedule	NP.21.39
Climb and Cruise Procedure	NP.21.40

Descent Procedure	NP.21.41
Approach Procedure	NP.21.42
Flap Extension Schedule	NP.21.42
Landing Procedure - ILS	NP.21.43
Landing Procedure - Instrument Approach Using VNAV	NP.21.45
Go-Around and Missed Approach Procedure	NP.21.47
Landing Roll Procedure	NP.21.49
After Landing Procedure	NP.21.50
Shutdown Procedure	NP.21.52
Secure Procedure	NP.21.55

Normal Procedures**Chapter NP****Introduction****Section 11**

General

This chapter gives:

- an introduction to the normal procedures philosophy and assumptions
- step by step normal procedures

Normal Procedures Philosophy and Assumptions

Normal procedures verify for each phase of flight that:

- the airplane condition is satisfactory
- the flight deck configuration is correct

Normal procedures are done on each flight. Refer to the Supplementary Procedures (SP) chapter for procedures that are done as required, for example the adverse weather procedures.

Normal procedures are used by a trained flight crew and assume:

- all systems operate normally
- the full use of all automated features (LNAV, VNAV, autoland, autopilot, and autothrottle)

Normal procedures also assume coordination with the ground crew before:

- hydraulic system pressurization, or
- flight control surface movement, or
- airplane movement

Normal procedures do not include steps for flight deck lighting and crew comfort items.

Normal procedures are done by memory and scan flow. The panel illustration in this section shows the scan flow. The scan flow sequence may be changed as required.

Configuration Check

It is the crew member's responsibility to verify correct system response. Before engine start, use lights or indications to verify each system's condition or configuration.

If there is an incorrect configuration or response:

- verify that the system controls are set correctly
- check the respective circuit breaker as required. Maintenance must first determine that it is safe to reset a tripped circuit breaker on the ground
- test the respective system light as required

Before engine start, review the EICAS alert messages and status display. If there are unexpected messages:

- check the Dispatch Deviations Guide (DDG) or the operator equivalent to decide if the condition has a dispatch effect
- decide if maintenance is needed

If, during or after engine start, there is an alert message:

- do the respective non-normal checklist (NNC)
- on the ground, check the DDG or the operator equivalent

After engine start, EICAS alert messages are the primary means of alerting the flight crew to non-normal conditions or incorrect configurations.

After engine start, there is no need to check status messages. Any message that has an adverse affect on safe continuation of the flight appears as an EICAS alert message.

Crew Duties

Preflight and postflight crew duties are divided between the Captain and First Officer. Phase of flight duties are divided between the Pilot Flying (PF) and the Pilot Monitoring (PM).

Each crewmember is responsible for moving the controls and switches in their area of responsibility:

- The phase of flight areas of responsibility for both normal and non-normal procedures are shown in the Area of Responsibility illustration in this section. Typical panel locations are shown.
- The preflight and postflight areas of responsibility are defined by the "Preflight Procedure - Captain" and "Preflight Procedure - First Officer".

The Captain may direct actions outside of the crewmember's area of responsibility.

The general PF phase of flight responsibilities are:

- taxiing
- flight path and airspeed control
- airplane configuration
- navigation

The general PM phase of flight responsibilities are:

- checklist reading
- communications
- tasks asked for by the PF
- monitoring taxiing, flight path, airspeed, airplane configuration, and navigation

PF and PM duties may change during a flight. For example, the Captain could be the PF during taxi but be the PM during takeoff through landing.

Normal procedures show who does a step by crew position (C, F/O, PF, or PM):

- in the procedure title, or
- in the far right column, or
- in the column heading of a table

The mode control panel is the PF's responsibility. When flying manually, the PF directs the PM to make the changes on the mode control panel.

The Captain is the final authority for all tasks directed and done.

Control Display Unit (CDU) Procedures

Before taxi, the Captain or First Officer may make CDU entries. The other pilot must verify the entries.

Make CDU entries before taxi or when stopped, when possible. If CDU entries must be made during taxi, the PM makes the entries. The PF must verify the entries before they are executed.

In flight, the PM usually makes the CDU entries. The PF may also make simple, CDU entries when the workload allows. The pilot making the entries executes the change only after the other pilot verifies the entries.

During high workload times, for example departure or arrival, try to reduce the need for CDU entries. Do this by using the MCP heading, altitude, and speed control modes. The MCP can be easier to use than entering complex route modifications into the CDU.

Autopilot Flight Director System (AFDS) Procedures

The crew must always monitor:

- airplane course
- vertical path
- speed

When selecting a value on the MCP, verify that the respective value changes on the flight instruments, as applicable.

The crew must verify manually selected or automatic AFDS changes. Use the FMA to verify mode changes for the:

- autopilot
- flight director
- autothrottle

During LNAV and VNAV operations, verify all changes to the airplane's:

- course
- vertical path
- thrust
- speed

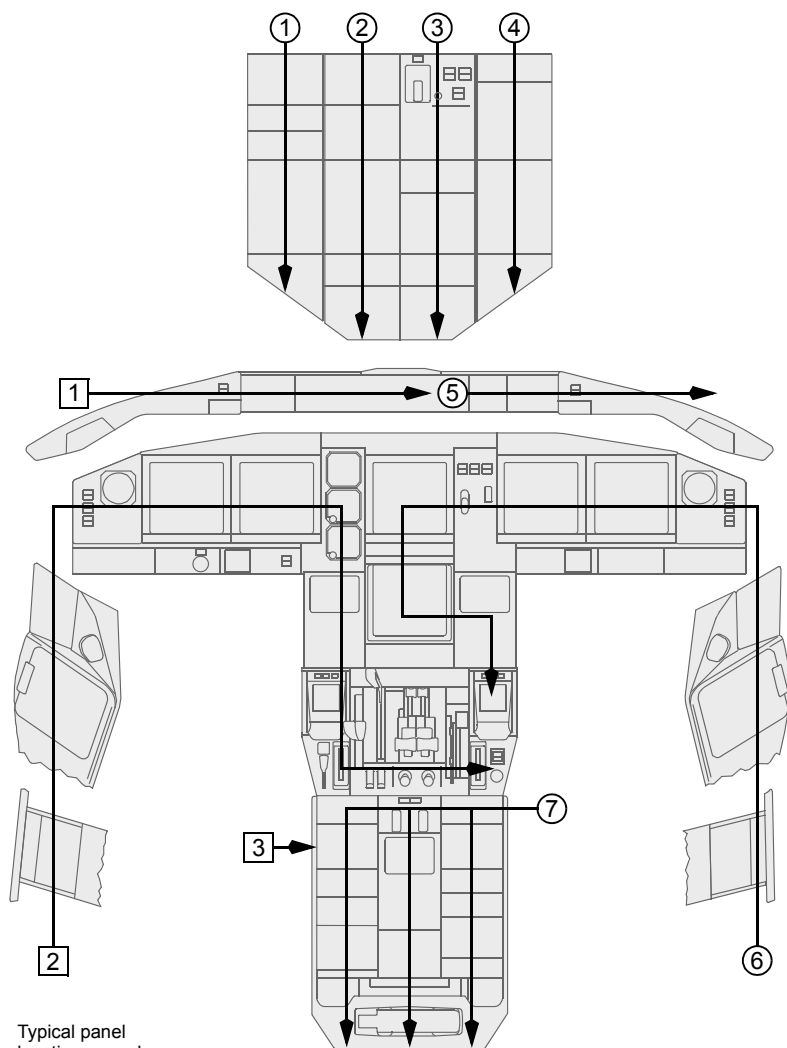
Announcing changes on the FMA and thrust mode display when they occur is a good CRM practice.

Preflight and Postflight Scan Flow

The scan flow and areas of responsibility diagrams shown below are representative and may not match the configuration(s) of your airplanes.

The scan flow diagram provides general guidance on the order each flight crew member should follow when doing the preflight and postflight procedures. Specific guidance on the items to be checked are detailed in the amplified Normal Procedures. For example, preflight procedure details are in the Preflight Procedure - Captain and Preflight Procedure - First Officer.

777 Flight Crew Operations Manual

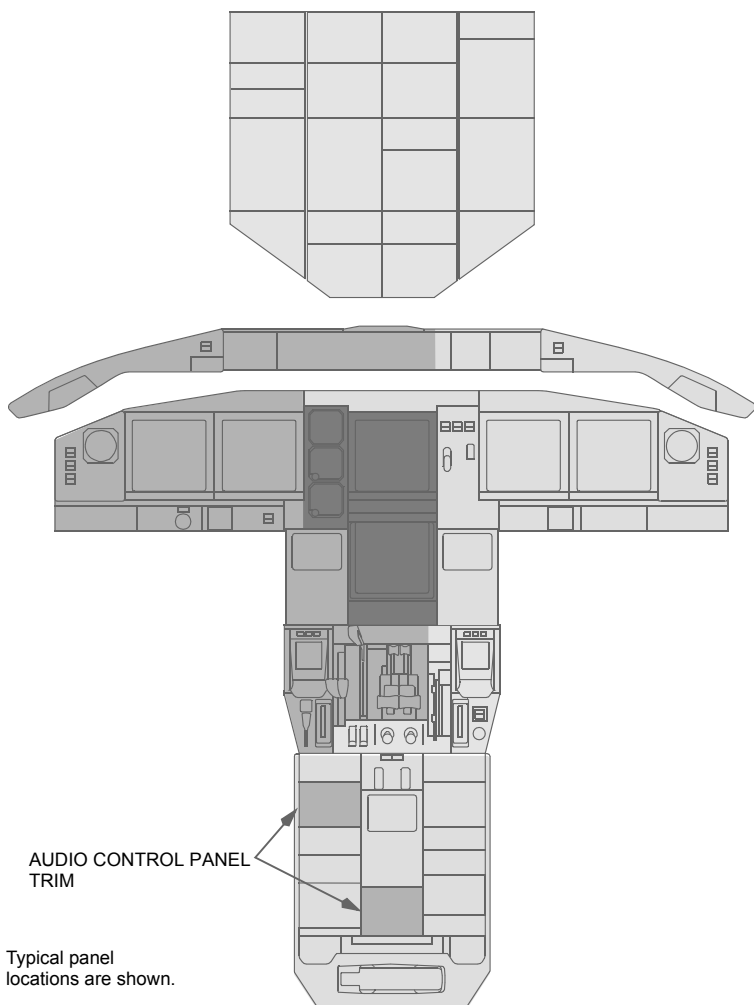


Typical panel
locations are shown.

□ CAPTAIN ITEMS

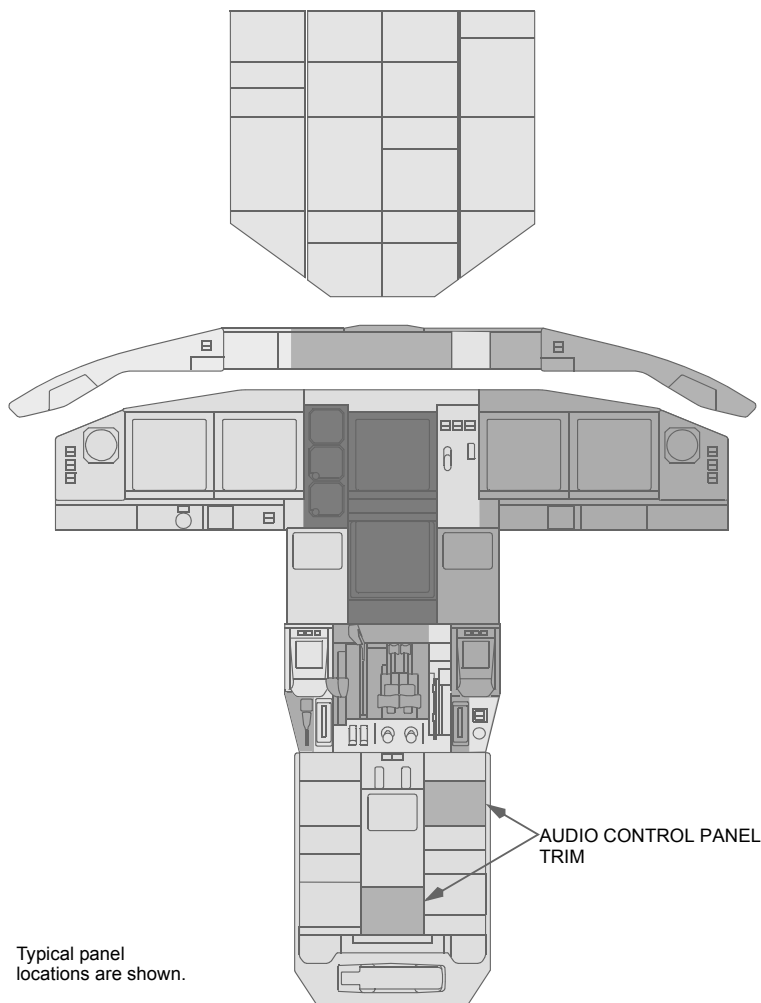
○ FIRST OFFICER
ITEMS

Areas of Responsibility - Captain as Pilot Flying or Taxiing



Typical panel
locations are shown.

-  CAPTAIN ITEMS
-  FIRST OFFICER ITEMS
-  JOINT RESPONSIBILITY
ITEMS

Areas of Responsibility - First Officer as Pilot Flying or Taxiing

Typical panel
locations are shown.

-  CAPTAIN ITEMS
-  FIRST OFFICER ITEMS
-  JOINT RESPONSIBILITY
ITEMS

Intentionally
Blank

Preliminary Preflight Procedure – Captain or First Officer

The Preliminary Preflight Procedure assumes that the Electrical Power Up supplementary procedure is complete.

ADIRU switch OFF 30 seconds, then ON

Verify that the ON BAT light is extinguished.

Verify that the OFF light is extinguished.

[Option]

VOICE RECORDER switch As needed

STATUS display Check

Verify that only expected messages are shown.

Verify that the following are sufficient for flight:

- oxygen pressure
- hydraulic quantity
- engine oil quantity

Do the remaining actions after a crew change or maintenance action.

Maintenance documents Check

[\[Flight Deck Security Door\]](#)

FLIGHT DECK ACCESS SYSTEM switch Guard closed

Emergency equipment Check

Fire extinguisher – Checked and stowed

Crash axe – Stowed

Escape ropes – Stowed

Other needed equipment – Checked and stowed

Overhead maintenance panel Guards closed

Verify that all lights are extinguished.

[\[Medical Power Outlets\]](#)

MEDICAL OUTLETS POWER switches – As needed

CARGO TEMPERATURE selectors – As needed

Circuit breakers Check

Parking brake As needed

Set the parking brake if brake wear indicators will be checked during the exterior inspection.

CDU Preflight Procedure - Captain and First Officer

Start the CDU Preflight Procedure anytime after the Preliminary Preflight Procedure. The Initial Data and Navigation Data entries must be complete before the flight instrument check during the Preflight Procedure. The Performance Data entries must be complete before the Before Start Checklist.

The Captain or First Officer may make CDU entries. The other pilot must verify the entries.

Enter data in all the boxed items on the following CDU pages.

Enter data in the dashed items or modify small font items that are listed in this procedure. Enter or modify other items at pilot's discretion.

Failure to enter enroute winds can result in flight plan time and fuel burn errors.

Initial DataSet

IDENT page:

Verify that the MODEL is correct.

Verify that the ENG RATING is correct.

Verify that the navigation data base ACTIVE date range is current.

POS INIT page:

Verify that the time is correct.

Enter the present position on the SET INERTIAL POS line. Use the most accurate latitude and longitude.

Navigation Data Set

RTE page:

Enter the route.

Enter the FLIGHT NUMBER.

Activate and execute the route.

DEPARTURES page:

Select the runway and departure routing.

Execute the runway and departure routing.

Verify that the route is correct on the RTE page. Check the LEGS pages as needed to ensure compliance with the flight plan.

Verify or enter the correct RNP for the departure.

NAV RADIO page:

Tune the navigation radios as needed.

Performance Data Set

PERF INIT page:

**CAUTION: Do not enter the ZFW into the GR WT boxes.
The FMC will calculate performance data with
significant errors.**

Enter the ZFW.

Verify that the FUEL on the CDU, the dispatch papers, and EICAS agree.

Verify that the fuel is sufficient for flight.

Verify that the GR WT on the CDU and the dispatch papers agree.

THRUST LIM page:

Select an assumed temperature, or a fixed derate takeoff, or both as needed.

[\[777-200LR, 777-300ER, 777-200FRTTR\]](#)

Select the APU to pack mode, if needed.

Select a full or a derated climb thrust as needed.

TAKEOFF REF page:

[\[Datalink T/O Pages\]](#)

Make data entries on page 2/2 before page 1/2.

[\[Non-Datalink T/O Pages\]](#)

Select or enter the takeoff V speeds.

Exterior Inspection

Before each flight the Captain, First Officer, or maintenance crew must verify that the airplane is satisfactory for flight.

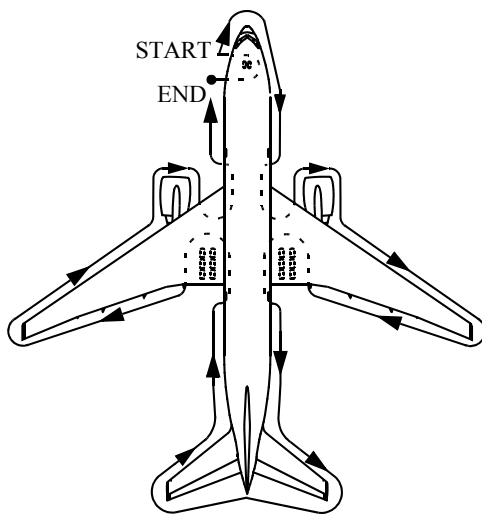
Items at each location may be checked in any sequence.

Use the detailed inspection route below to check that:

- the surfaces and structures are clear, not damaged, not missing parts and there are no fluid leaks
- the tires are not too worn, not damaged, and there is no tread separation
- the gear struts are not fully compressed
- the engine inlets and tailpipes are clear, the access panels are secured, the exterior is not damaged, and the reversers are stowed
- the doors and access panels that are not in use are latched
- the probes, vents, and static ports are clear and not damaged
- the skin area adjacent to the pitot probes and static ports is not wrinkled
- the antennae are not damaged
- the light lenses are clean and not damaged

For cold weather operations see the Supplementary Procedures.

Inspection Route



Left Forward Fuselage

Probes, sensors, ports, vents, and drains (as applicable) Check
Doors and access panels (not in use) Latched
Oxygen pressure relief green disc In place
Forward outflow valve Check

Nose

Radome Check
Diverter strips - Secure
Forward access door Secure

Nose Wheel Well

Tires and wheels Check
Gear strut and doors Check
Nose wheel steering assembly Check
Gear pin As needed
Nose gear towing lever NORMAL
Nose gear towing lever pin Verify removed
Exterior lights Check
Wheel well light switches As needed
Forward E and E door Secure

Right Forward Fuselage

Probes, sensors, ports, vents, and drains (as applicable) Check
Doors and access panels (not in use) Latched
Negative pressure relief vents Closed

Right Wing Root, Pack, and Lower Fuselage

Probes, sensors, ports, vents, and drains (as applicable)	Check
Exterior lights	Check
Pack inlet and pneumatic access doors	Secure
Leading edge flaps	Check

Right Engine

Access panels	Latched
Probes, sensors, ports, vents, and drains (as applicable)	Check
Fan blades, probes, and spinner	Check
Thrust reverser	Stowed
Exhaust area and tailcone	Check

Right Wing and Leading Edge

Access panels	Latched
Leading edge slats	Check
Fuel measuring sticks	Flush and secure
Wing Surfaces	Check
Fuel tank vent	Check

Right Wing Tip and Trailing Edge

Navigation and strobe lights	Check
Static discharge wicks	Check
Fuel jettison nozzle	Check
Aileron, flap, and trailing edge flaps	Check

Right Main Gear

Tires, brakes and wheels Check

Verify that the wheel chocks are in place as needed.

If the parking brake is set, the brake wear indicator pins must extend out of the guides.

Gear strut, actuators, and doors Check

Hydraulic lines Secure

Gear pins As needed

Right Main Wheel Well

Wheel well Check

Right Aft Fuselage

Ram air turbine door Check

Doors and access panels (not in use) Latched

Probes, sensors, ports, vents, and drains (as applicable) Check

[\[Gaseous Oxygen\]](#)

Oxygen pressure relief green disc In place

Tail

Vertical stabilizer and rudder Check

[\[777-300, 777-300ER\]](#)

Tail skid Check

Verify that the tail skid is not damaged.

Horizontal stabilizer and elevator Check

Static discharge wicks Check

Strobe light Check

APU exhaust outlet Check

Left Aft Fuselage

Aft outflow valve Check
Doors and access panels (not in use)..... Latched
Probes, sensors, ports, vents, and drains (as applicable)..... Check

Left Main Wheel Well

Wheel well Check

Left Main Gear

Tires, brakes and wheels Check
Verify that the wheel chocks are in place as needed.
If the parking brake is set, the brake wear indicator pins must extend out of the guides.
Gear strut, actuators and doors Check
Hydraulic lines Secure
Gear pins As needed

Left Wing Tip and Trailing Edge

Navigation and strobe lights Check
Static discharge wicks Check
Aileron, flaperon, and trailing edge flaps..... Check
Fuel jettison nozzle Check
Fuel tank vent Check

Left Wing and Leading Edge

Wing Surfaces Check
Fuel measuring sticks Flush and secure
Fuel tank vent Check
Leading edge slats Check
Access panels Latched

Left Engine

Exhaust area and tailcone Check
Thrust reverser Stowed
Probes, sensors, ports, vents, and drains (as applicable) Check
Access panels Latched
Fan blades, probes, and spinner Check

Left Wing Root, Pack, and Lower Fuselage

Probes, sensors, ports, vents, and drains (as applicable) Check
Exterior lights Check
Pack inlet and pneumatic access doors Secure
Negative pressure relief vents Closed
Positive pressure relief valves Closed
Leading edge flaps Check

Preflight Procedure – First Officer

The First Officer normally does this procedure. The Captain may do this procedure as needed.

THRUST ASYMMETRY COMPENSATION
switch AUTO

Verify that the OFF light is extinguished.

PRIMARY FLIGHT COMPUTERS
DISCONNECT switch Guard closed

Verify that the DISC light is extinguished.

ELECTRICAL panel Set

BATTERY switch – ON

Verify that the OFF light is extinguished.

IFE/PASS SEATS power switch – ON

Verify that the OFF light is extinguished.

CABIN/UTILITY power switch – ON

Verify that the OFF light is extinguished.

APU GENERATOR switch – ON

Verify that the OFF light is extinguished.

BUS TIE switches – AUTO

Verify that the ISLN lights are extinguished.

GENERATOR CONTROL switches – ON

Verify that the OFF lights are illuminated.

Verify that the DRIVE lights are illuminated.

BACKUP GENERATOR switches – ON

The OFF lights stay illuminated until the respective engine is started.

APU selector (as needed) START, then ON

Do not allow the APU selector to spring back to the ON position.

Verify that the FAULT light is extinguished.

[\[777-300, 777-300ER\]](#)

CAMERA LIGHTS switch As needed

L WIPER selector OFF[\[Option\]](#)

GROUND PROXIMITY RUNWAY OVERRIDE switch Off

[\[Option\]](#)

ELT switch Guard closed

EMERGENCY LIGHTS switch Guard closed

SERVICE INTERPHONE switch OFF

[\[Gaseous Passenger Oxygen\]](#)**Note:** Do not set the PASSENGER OXYGEN switch to ON. The switch causes deployment of the passenger oxygen masks.[\[Gaseous Passenger Oxygen\]](#)

PASSENGER OXYGEN SWITCH Guard closed

[\[Chemical Passenger Oxygen\]](#)**Note:** Do not push the PASSENGER OXYGEN switch. The switch causes deployment of the passenger oxygen masks.[\[Chemical Passenger Oxygen\]](#)

PASSENGER OXYGEN ON light Verify extinguished

[\[777 Freighter\]](#)**Note:** Do not set the SUPRNMRY OXYGEN switch to ON. The switch causes deployment of the supernumerary oxygen masks.[\[777 Freighter\]](#)

SUPRNMRY OXYGEN switch Guard closed

WINDOW HEAT switches ON

Verify that the INOP lights are extinguished.

WARNING: Do not push the RAM AIR TURBINE switch. The switch causes deployment of the ram air turbine.

RAM AIR TURBINE UNLOCKED light Verify extinguished

HYDRAULIC panel Set

LEFT and RIGHT ENGINE PRIMARY pump switches – ON

Verify that the FAULT lights are illuminated.

Center 1 and Center 2 ELECTRIC PRIMARY pump switches – OFF

Verify that the FAULT lights are illuminated.

DEMAND pump selectors – OFF

Verify that the FAULT lights are illuminated.

[Passenger]

PASSENGER SIGNS panel Set

[Option]

NO SMOKING selector – AUTO or ON

SEAT BELTS selector – AUTO or ON

[777 Freighter]

SUPRNMRY SIGNS panel Set

[Option]

NO SMOKING selector – AUTO or ON

SEAT BELTS selector – AUTO or ON

Lighting panel Set

OVERHEAD panel light control – Mid position

CIRCUIT BREAKER panel light control – Mid position

MASTER BRIGHTNESS switch – ON

MASTER BRIGHTNESS control – As needed

GLARESHIELD PANEL light control – Mid position

FLOOD light control – Mid position

LANDING light switches – OFF

APU fire panel Set

Verify that the APU BTL DISCH light is extinguished.

APU fire switch – In

Verify that the APU fire warning light is extinguished.

[777 Passenger]

CARGO FIRE panelSet

CARGO FIRE ARM switches – Off

Verify that the FWD and AFT fire warning lights are extinguished.

Verify that the cargo fire DISCH light is extinguished.

[777 Freighter]

CARGO FIRE panelSet

CARGO FIRE ARM switches – Off

Verify that the MAIN, FWD and AFT fire warning lights are extinguished.

Verify that the cargo fire DISCH and DEPR light is extinguished.

ENGINE panelSet

EEC MODE switches – NORM

[GE Engines with CON Position, PW Engines]

START/IGNITION selectors – NORM

[GE Engines without CON Position, RR Engines]

START selectors – NORM

AUTOSTART switch – ON

Verify that the OFF light is extinguished.

FUEL JETTISON panelSet

FUEL JETTISON NOZZLE switches – Off

Verify that the VALVE lights are extinguished.

FUEL TO REMAIN selector – IN

FUEL JETTISON ARM switch – Off

Verify that the FAULT light is extinguished.

FUEL panel Set

CROSSFEED switches – OFF

Verify that the VALVE lights are extinguished.

FUEL PUMP switches – OFF

Verify that the left forward pump PRESS light is extinguished if the APU is on or is illuminated if the APU is off.

Verify that the other left and right pump PRESS lights are illuminated.

Verify that the center pump PRESS lights are extinguished.

[Auxiliary Fuel Tank]

AUXILIARY FUEL switch - OFF

Verify the auxiliary fuel switch PRESS light is extinguished.

ANTI-ICE panel Set

WING anti-ice selector – AUTO

ENGINE anti-ice selectors – AUTO

Lighting panel Set

BEACON light switch – OFF

NAVIGATION light switch – As needed

LOGO light switch – As needed

WING light switch – As needed

INDICATOR LIGHTS switch – As needed

RUNWAY TURNOFF light switches – OFF

TAXI light switch – OFF

STROBE light switch – OFF

[Option]

FORWARD CARGO AIR CONDITIONING As needed

[777 Freighter]

LWR CARGO TEMP panel Set

FORWARD LOWER CARGO

AIR CONDITIONING control- As needed

AFT LOWER CARGO AIR CONDITIONING control - As needed

AIR CONDITIONING panelSet

[\[Flight Deck Humidification\]](#)

HUMIDIFICATION switch – ON

EQUIPMENT COOLING switch – AUTO

Verify that the OVRD light is extinguished.

[\[777 Freighter\]](#)

RECIRCULATION FANS switch – ON

[\[777 Freighter\]](#)

MAIN DECK FLOW control – NORMAL

[\[777 Freighter\]](#)

ALTERNATE VENTILATION switch – OFF

[\[Gasper Air\]](#)

GASPER switch – ON

[\[777 Passenger\]](#)

RECIRCULATION FANS switches – ON

FLIGHT DECK TEMPERATURE control – mid AUTO position

[\[777 Passenger\]](#)

CABIN TEMPERATURE control – Mid position

[\[777 Freighter\]](#)

FORWARD MAIN DECK CARGO

TEMPERATURE control – As needed

[\[777 Freighter\]](#)

AFT MAIN DECK CARGO

TEMPERATURE control – As needed

PACK switches – AUTO

Verify that the OFF lights are extinguished.

TRIM AIR switches – ON

Verify that the FAULT lights are extinguished.

BLEED AIR panel Set

LEFT, CENTER and RIGHT ISOLATION switches – AUTO

Verify that the CLOSED lights are extinguished.

ENGINE bleed switches – ON

The OFF lights stay illuminated until the respective engine is started.

APU bleed switch – AUTO

Verify that the OFF light is extinguished.

PRESSURIZATION panel Set

OUTFLOW VALVE switches – AUTO

Verify that the MAN lights are extinguished.

LANDING ALTITUDE selector – IN

R WIPER selector OFF

FLIGHT DIRECTOR switch ON

Display select panel..... Set

LOWER CENTER display switch – Push

EFIS control panel Set

MINIMUMS reference selector – RADIO or BARO

MINIMUMS selector – Set decision height or altitude reference

FLIGHT PATH VECTOR switch – As needed

METERS switch – As needed

BAROMETRIC reference selector – IN or HPA

BAROMETRIC selector – Set local altimeter setting

VOR/ADF switches – As needed

ND mode selector – MAP

ND CENTER switch – As needed

ND range selector – As needed

ND TRAFFIC switch – As needed

WEATHER RADAR – Off

Verify that the weather radar indications are not shown on the ND.

Map switches – As needed

Oxygen Test and set

Oxygen mask – Stowed and doors closed

RESET/TEST switch – Push and hold

Verify that the yellow cross shows momentarily in the flow indicator.

EMERGENCY/TEST selector – Push and hold

Continue to hold the RESET/TEST switch down and push the EMERGENCY/TEST selector. Verify that the yellow cross shows continuously in the flow indicator.

RESET/TEST switch and EMERGENCY/TEST selector – Release

Verify that the yellow cross does not show in the flow indicator.

Normal/100% selector – 100%

[\[Gaseous Passenger Oxygen\]](#)

Crew and passenger oxygen pressure – Check EICAS

Verify that the pressure is sufficient for dispatch.

[\[Chemical Passenger Oxygen\]](#)

Crew oxygen pressure – Check EICAS

Verify that the pressure is sufficient for dispatch.

[\[777 Freighter\]](#)

Crew and supernumerary oxygen pressure – Check EICAS

Verify that the pressure is sufficient for dispatch.

[\[Option\]](#)

ELECTRONIC FLIGHT BAG Set

[\[Option\]](#)

SIDE DISPLAY control As needed

FORWARD PANEL BRIGHTNESS controls Mid position

Instrument source select panel Set

NAVIGATION source switch – Off

DISPLAY CONTROL source switch – Off

AIR DATA/ATT source switch – Off

Clock Set

Time/date selector – UTC

INBOARD DISPLAY selector MFD

FMC Selector AUTO

Do the Initial Data and Navigation Data steps from the CDU Preflight Procedure and verify that the IRS alignment is complete before checking the flight instruments.

Flight instruments Check

Verify that the flight instrument indications are correct.

Verify that only these flags are shown:

- TCAS OFF
- NO VSPD until takeoff V-speeds are selected

Verify that the flight mode annunciations are correct:

- autothrottle mode is blank
- roll mode is TO/GA
- pitch mode is TO/GA
- AFDS status is FLT DIR

Select the map mode.

Landing gear panel Set

Verify that the GND PROX light is extinguished.

FLAP OVERRIDE switch – Off

GEAR OVERRIDE switch – Off

TERRAIN OVERRIDE switch – Off

Landing gear lever – DN

ALTERNATE GEAR switch – Guard closed

AUTOBRAKE selector – RTO

EICAS display Check

Verify that the primary engine indications show existing conditions.

Verify that no exceedance is shown.

MFD Check

Secondary ENGINE indications – Check

Verify that the secondary engine indications show existing conditions.

Verify that no exceedance is shown.

STATUS display switch – Push.

Check status messages.

CHECKLIST display switch – Push

LOWER CENTER cursor location switch – Push

Verify that the lower center cursor location light is illuminated.

RESETS – Select

[\[Dual Database\]](#)

Verify the AIRLINE DATABASE is current.

RESET ALL – Select

[\[Datalink NOT Automatically Reset\]](#)

COMMUNICATION display switch – Push

MANAGER – Select

MASTER – Select

DATA LINK SYSTEM RESET – Select

CONFIRM RESET – Select

Center DISPLAY CONTROL source switch Off

CENTER PANEL BRIGHTNESS controls Mid position

Left radio tuning panel Set

Verify that the OFF light is extinguished.

WEATHER RADAR panel	Set
Center radio tuning panel	Set
Verify that the OFF light is extinguished.	
Observer's audio control panel	As needed
[777 Freighter - the step below is not applicable]	
Flight deck door panel	As needed
Engine fire panel	Set
Verify that the ENG BTL 1 DISCH and ENG BTL 2 DISCH lights are extinguished.	
Engine fire switches – In	
Verify that the LEFT and RIGHT fire warning lights are extinguished.	
Center CDU	Set
Flight deck printer	Set
Verify that the PAPER light is extinguished.	
Right radio tuning panel	Set
Verify that the OFF light is extinguished.	
First Officer audio control panel	As needed
Transponder panel	Set
[Option]	
Evacuation COMMAND switch	Guard closed
FLOOR LIGHTS switch	As needed
OBSERVER AUDIO selector	NORM
AISLE STAND PANEL light control	Mid position
AISLE STAND FLOOD light control	Mid position
WARNING: Do not put objects between the seat and the aisle stand. Injury can occur when the seat is adjusted.	
Seat	Adjust
Adjust the seat for optimum eye reference.	

Rudder pedals Adjust

Adjust the rudder pedals to allow full rudder pedal and brake pedal movement. Stow the rudder pedal adjust crank.

Seat belt and shoulder harness Adjust

Do the PREFLIGHT checklist on the Captain's command.

Preflight Procedure – Captain

The Captain normally does this procedure. The First Officer may do this procedure if needed.

EFIS control panel Set

MINIMUMS reference selector – RADIO or BARO

MINIMUMS selector – Set decision height or altitude reference

FLIGHT PATH VECTOR switch – As needed

METERS switch – As needed

BAROMETRIC reference selector – IN or HPA

BAROMETRIC selector – Set local altimeter setting

VOR/ADF switches – As needed

ND mode selector – MAP

ND CENTER switch – As needed

ND range selector – As needed

ND TRAFFIC switch – As needed

WEATHER RADAR – Off

Verify that the weather radar indications are not shown on the ND.

Map switches – As needed

Mode control panel Set

FLIGHT DIRECTOR switch – ON

AUTOTHROTTLE ARM switches – ARM

Autopilot DISENGAGE bar – UP

HEADING/TRACK reference switch – As needed

BANK LIMIT selector – AUTO

VERTICAL SPEED/FLIGHT PATH ANGLE reference switch – As needed

ALTITUDE increment selector – As needed

Oxygen Test and set

Oxygen mask – Stowed and doors closed

RESET/TEST switch – Push and hold

Verify that the yellow cross shows momentarily in the flow indicator.

EMERGENCY/TEST selector – Push and hold

Continue to hold the RESET/TEST switch down and push the EMERGENCY/TEST selector. Verify that the yellow cross shows continuously in the flow indicator.

RESET/TEST switch and EMERGENCY/TEST selector – Release

Verify the yellow cross does not show in the flow indicator.

Normal/100% selector – 100%

[\[Gaseous Passenger Oxygen\]](#)

Crew and passenger oxygen pressure – Check EICAS

Verify that the pressure is sufficient for dispatch.

[\[Chemical Passenger Oxygen\]](#)

Crew oxygen pressure – Check EICAS

Verify that the pressure is sufficient for dispatch.

[\[777 Freighter\]](#)

Crew and supernumerary oxygen pressure – Check EICAS

Verify that the pressure is sufficient for dispatch.

[\[Option\]](#)

ELECTRONIC FLIGHT BAG Set

[\[Option\]](#)

SIDE DISPLAY control As needed

FORWARD PANEL BRIGHTNESS controls Mid position

Instrument source select panel Set

NAVIGATION source switch – Off

DISPLAY CONTROL source switch – Off

AIR DATA/ATTITUDE source switch – Off

Clock Set

Time/date selector – UTC

INBOARD DISPLAY selector MFD

HEADING REFERENCE switch NORM

Do the Initial Data and Navigation Data steps from the CDU Preflight Procedure and verify that the IRS alignment is complete before checking the flight instruments.

Flight instruments Check

Verify that the flight instrument indications are correct.

Verify that only these flags are shown:

- TCAS OFF
- NO VSPD until takeoff V–speeds are selected

Verify that the flight mode annunciations are correct:

- autothrottle mode is blank
- roll mode is TO/GA
- pitch mode is TO/GA
- AFDS status is FLT DIR

Select the map mode.

[\[Standby Flight Instruments - non ISFD\]](#)

Standby instruments Check

Set local altimeter setting.

Verify that the flight instrument indications are correct.

Verify that no flags or messages are shown.

Verify not blank.

[\[Integrated Standby Flight Display - ISFD\]](#)

Integrated standby flight display Set

Verify that the approach mode display is blank.

Set local altimeter setting.

Verify that the flight instrument indications are correct.

Verify that no flags or messages are shown.

ALTERNATE PITCH TRIM levers Neutral

SPEEDBRAKE lever DOWN

-
- Reverse thrust levers Down
- Forward thrust levers Closed
- Flap lever Set
- The flap position indicator does not show when the flaps are up.
- Set the flap lever to agree with the flap position.
- Parking brake Set
- Verify that the PARKING BRAKE SET message is shown.
- Note:** Do not assume that the parking brake will prevent airplane movement. Accumulator pressure can be insufficient.
- STABILIZER cutout switches Guards closed
- FUEL CONTROL switches CUTOFF
- FUEL CONTROL switch fire warning lights Verify extinguished
- ALTERNATE FLAPS panel Set
- ALTERNATE FLAPS ARM switch – OFF
- ALTERNATE FLAPS selector – OFF
- Captain audio control panel As needed
- WARNING: Do not put objects between the seat and the aisle stand. Injury can occur when the seat is adjusted.**
- Seat Adjust
- Adjust the seat for optimum eye reference.
- Rudder pedals Adjust
- Adjust the rudder pedals to allow full rudder pedal and brake pedal movement. Stow the rudder pedal adjust crank.
- Seat belt and shoulder harness Adjust
- Call “PREFLIGHT CHECKLIST.”

Before Start Procedure

Start the Before Start Procedure after papers are on board.

[\[777 Freighter - the step below is not applicable\]](#)

Flight deck door Closed and locked F/O

Verify that the LOCK FAIL light is extinguished.

Do the CDU Preflight Procedure – Performance Data steps before completing this procedure.

CDU display Set C, F/O

Normally the PF selects the TAKEOFF REF page.

Normally the PM selects the LEGS page.

MCP Set C

IAS/MACH selector – Set V2

Arm LNAV as needed.

Arm VNAV.

Initial heading or track – Set

Initial altitude – Set

Taxi and Takeoff briefings Complete C, F/O

The pilot who will do the takeoff does the taxi and takeoff briefings.

Exterior doors Verify closed F/O

Flight deck windows Closed and locked C, F/O

Verify that the WINDOW NOT CLOSED decal does not show.

Verify that the orange indicator does not show.

Start clearance Obtain C, F/O

Obtain a clearance to pressurize the hydraulic systems.

Obtain a clearance to start the engines.

If pushback is needed:

Nose gear steering Verify locked out C

HYDRAULIC panel Set F/O

WARNING: If the tow bar is connected, do not pressurize the hydraulic systems until the nose gear steering is locked out. Unwanted tow bar movement can occur.

Note: Pressurize the right system first to prevent fluid transfer between systems.

Right ELECTRIC DEMAND pump selector – AUTO
Verify that FAULT light is extinguished.

Center 1 and Center 2 ELECTRIC PRIMARY pump switches – ON
Verify that the Center 1 FAULT light is extinguished.
The Center 2 FAULT light may stay illuminated until after engine start because of load shedding.

Left ELECTRIC DEMAND pump selector – AUTO
Verify that the FAULT light is extinguished.

Center 1 and Center 2 AIR DEMAND pump selectors – AUTO
Verify that the FAULT lights are extinguished.

Fuel panel Set F/O

LEFT and RIGHT FUEL PUMP switches – ON
Verify that the PRESS lights are extinguished.

[After PRR 61998-2 - English Units -200]

If there is more than 7,500 pounds of fuel in the center tank:

CENTER FUEL PUMP switches – ON

One or both PRESS lights may stay illuminated until after the engine start because of load shedding.

[After PRR 61998-2 Metric Units -200]

If there is more than 3,400 kilograms of fuel in the center tank:

CENTER FUEL PUMP switches – ON

One or both PRESS lights may stay illuminated until after the engine start because of load shedding.

[After PRR 61998-2 - English Units not -200]

If there is more than 10,500 pounds of fuel in the center tank:

CENTER FUEL PUMP switches – ON

One or both PRESS lights may stay illuminated until after the engine start because of load shedding.

[After PRR 61998-2 - Metric Units not -200]

If there is more than 4,800 kilograms of fuel in the center tank:

CENTER FUEL PUMP switches – ON

One or both PRESS lights may stay illuminated until after the engine start because of load shedding.

[Auxiliary Fuel Tank]

If there is more than 100 kilograms of fuel in the auxiliary tank:

AUXILIARY FUEL switch – ON

Verify that the PRESS light is extinguished.

Note: Failure to push the auxiliary fuel switch ON may result in unusable fuel.

[Auxiliary Fuel Tank]

If there is more than 200 pounds of fuel in the auxiliary tank:

AUXILIARY FUEL switch – ON

Verify that the PRESS light is extinguished.

Note: Failure to push the auxiliary fuel switch ON may result in unusable fuel.

BEACON light switch ON F/O

CANCEL/RECALL switch Push F/O

Verify that only the expected alert messages are shown.

CANCEL/RECALL switch Push F/O

Verify that the messages cancel.

Trim Set C

Stabilizer trim – ____ UNITS

Set the trim for takeoff.

Verify that the trim is in the greenband.

Aileron trim – 0 units

Rudder trim – 0 units

Call “BEFORE START CHECKLIST.” C

Do the BEFORE START checklist. F/O

Pushback or Towing Procedure

The Engine Start procedure may be done during pushback or towing.

Ground handling personnel Establish communications C

CAUTION: Do not hold or turn the nose wheel tiller during pushback or towing. This can damage the nose gear or the tow bar.

CAUTION: Do not use airplane brakes to stop the airplane during pushback or towing. This can damage the nose gear or the tow bar.

Transponder As needed F/O

At airports where ground tracking is not available, select STANDBY. At airports equipped to track airplanes on the ground, select an active transponder setting, but not a TCAS mode.

Parking brake Set or release C

Set or release as directed by ground handling personnel.

When pushback or towing is complete:

Tow bar Verify not connected C

Nose gear steering Verify not locked out C

Engine Start Procedure

Select the secondary engine display. F/O

Start sequenceAnnounce C

[PW Engines, RR Engines]

The engines may be started at the same time.

Call “START ____ ENGINE” C

[GE Engines with CON Position, PW Engines]

Engine START/IGNITION selectorSTART F/O

[GE Engines without CON Position, RR Engines]

Engine START selectorSTART F/O

FUEL CONTROL switchRUN C

Verify that the oil pressure increases. C, F/O

[GE Engines]

After the engine is stable at idle, start the other engine.

[PW Engines, RR Engine]

If the engines were not started at the same time:

After the engine is stable at idle, start the other engine.

Autostart corrects for:

- no EGT rise
- a hot start
- a hung start
- no N1 rotation
- a compressor stall
- a starter shaft failure
- insufficient starter air pressure
- a start time that exceeds the maximum starter duty cycle time

Do the ABORTED ENGINE START checklist for the following abort start condition:

- there is no oil pressure indication after the EGT increases

Before Taxi Procedure

APU selector	OFF	F/O
ENGINE ANTI-ICE selectors	As needed	F/O
Verify that the ground equipment is clear.		C, F/O
Call “FLAPS___” as needed for takeoff.		C
Flap lever	Set takeoff flaps	F/O
Flight controls	Check	C

Note: To avoid nuisance FLIGHT CONTROLS faults, a complete cycle of the control wheel during the flight control check should be done slowly (more than approximately 6 seconds) and not combined with the check of the pitch controls.

Move the control wheel and the control column to full travel in both directions and verify:

- freedom of movement
- that the controls return to center

Hold the nose wheel tiller during the rudder check to prevent nose wheel movement.

Move the rudder pedals to full travel in both directions and verify:

- freedom of movement
- that the rudder pedals return to center

Transponder	As needed	F/O
-------------------	-----------	-----

At airports where ground tracking is not available, select STANDBY. At airports equipped to track airplanes on the ground, select an active transponder setting, but not a TCAS mode.

Recall	Check	C, F/O
--------------	-------	--------

Verify that only expected alert messages are shown.

[Electronic Flight Bag]

EFB AIRPORT MAP application	Select	C, F/O
-----------------------------------	--------	--------

Select map as desired.

CAUTION: Do not use the Airport Map application as a primary navigation reference. The Airport Map application is designed to aid flight crew positional awareness only.

Update changes to the taxi briefing, as needed.	C or PF
Call “BEFORE TAXI CHECKLIST.”	C
Do the BEFORE TAXI checklist.	F/O

Before Takeoff Procedure

[PW Engines]

Engine warm up requirements:

- engine oil temperature must be above the lower amber band before takeoff

Engine warm up recommendations (there is no need to delay the takeoff for these recommendations):

- when the engines have been shut down more than 2 hours:
 - run the engines for 5 minutes
- when taxi time is expected to be less than 5 minutes, start the engines as early as feasible
- use a thrust setting normally used for taxi operations

[GE Engines]

Engine warm up requirements:

- engine oil temperature must be above the bottom of the temperature scale

Engine warm up recommendations:

- run the engines for at least 3 minutes
- use a thrust setting normally used for taxi operations

[RR Engines]

Engine warm up requirements:

- when the engines have been shut down more than 1.5 hours:
 - run the engines for at least 5 minutes
- when the engines have been shut down less than 1.5 hours:
 - run the engines for at least 3 minutes
- use a thrust setting normally used for the taxi operations
- engine oil temperature must be above the lower amber band before takeoff

Pilot Flying	Pilot Monitoring
	[777 Passenger] Notify the cabin crew to prepare for takeoff. Verify that the cabin is secure. [777 Freighter] Notify the supernumeraries to prepare for takeoff.

The pilot who will do the takeoff updates changes to the takeoff briefing as needed.	
Set the weather radar display as needed. Set the terrain display as needed.	
Call “BEFORE TAKEOFF CHECKLIST.”	Do the BEFORE TAKEOFF checklist.

Takeoff Procedure

Pilot Flying	Pilot Monitoring
Before entering the departure runway, verify that the runway and runway entry point are correct.	
	When entering the departure runway, set the STROBE light switch to ON. Use other lights as needed. Set the transponder mode selector to TA/RA.
Verify that the brakes are released. Align the airplane with the runway.	When cleared for takeoff, set the LEFT and RIGHT LANDING light switches to ON.
Verify that the airplane heading agrees with the assigned runway heading.	
[GE Engines] Advance the thrust levers to approximately 55% N1. [PW Engines, RR Engines] Advance the thrust levers to approximately 1.05 EPR. Allow the engines to stabilize.	
Push the TO/GA switch.	
Verify that the correct takeoff thrust is set.	
	Monitor the engine instruments during the takeoff. Call out any abnormal indications. Adjust takeoff thrust before 80 knots as needed. During strong headwinds, if the thrust levers do not advance to the planned takeoff thrust by 80 knots, manually advance the thrust levers.
After takeoff thrust is set, the Captain's hand must be on the thrust levers until V1.	
Monitor airspeed. Maintain light forward pressure on the control column.	Monitor airspeed and call out any abnormal indications.

Verify 80 knots and call "CHECK."	Call "80 KNOTS."
Verify V1 speed.	Verify the automatic V1 callout or call "V1."
At VR, rotate toward 15° pitch attitude. After liftoff, follow F/D commands.	At VR call "ROTATE." Monitor airspeed and vertical speed.
Establish a positive rate of climb.	
	Verify a positive rate of climb on the altimeter and call "POSITIVE RATE."
Verify a positive rate of climb on the altimeter and call "GEAR UP."	
	Set the landing gear lever to UP.
Above 400 feet radio altitude, call for a roll mode as needed.	Select or verify the roll mode. Verify VNAV engaged.
Verify that climb thrust is set.	
Verify acceleration at the acceleration height. Call "FLAPS ____" according to the flap retraction schedule.	
	Set the flap lever as directed.
Engage the autopilot when above the minimum altitude for autopilot engagement.	
	After flap retraction is complete, set the ENGINE ANTI-ICE selectors to AUTO.
Call "AFTER TAKEOFF CHECKLIST."	
	Do the AFTER TAKEOFF checklist.

Takeoff Flap Retraction Speed Schedule

Takeoff Flaps	At “Display”	Select Flaps
20 or 15	VREF 30 + 20	5
	“5”	1
	“1”	UP
5	VREF 30 + 40	1
	“1”	UP

Climb and Cruise Procedure

Complete the After Takeoff Checklist before starting the Climb and Cruise Procedure.

Note: Maintain at least 15 knots above minimum maneuver speed when climbing through FL200 to prevent the EICAS caution message, “AIRSPEED LOW” from occurring.

Note: Perform all step climbs using VNAV or maximum climb thrust.

Pilot Flying	Pilot Monitoring
	At or above 10,000 feet MSL, set the LANDING light switches to OFF.
	[777 Passenger] Set the passenger signs as needed. [777 Freighter] Set the supernumerary signs as needed.
At transition altitude, set and crosscheck the altimeters to standard.	
	If the FUEL IN CENTER message shows, set both CENTER FUEL PUMP switches to ON. [Auxiliary Fuel Tank] When the FUEL LOW AUX message shows, set the AUXILIARY FUEL switch to OFF. When the FUEL LOW CENTER message shows, set both CENTER FUEL PUMP switches to OFF.
	Before the top of descent, modify the active route as needed for the arrival and approach. Verify or enter the correct RNP for the arrival.

Descent Procedure

Start the Descent Procedure before the airplane descends below the cruise altitude for arrival at destination.

Complete the Descent Procedure by 10,000 feet MSL.

[RR Engines]

During initial descent, maintain idle thrust for a minimum of 30 seconds.

Pilot Flying	Pilot Monitoring
Review all alert messages. Review all operational notes.	Recall and review all alert messages. Recall and review all operational notes.
Verify VREF on the APPROACH REF page.	Enter VREF on the APPROACH REF page.
Set the RADIO/BARO minimums as needed for the approach.	
	Set the NAV RADIO page for the approach.
	Set the AUTOBRAKE selector to the needed brake setting.
Do the approach briefing.	
Call “DESCENT CHECKLIST.”	Do the DESCENT checklist.

Approach Procedure

The Approach Procedure is normally started at transition level.

Complete the Approach Procedure before:

- the initial approach fix, or
- the start of radar vectors to the final approach course, or
- the start of a visual approach

Pilot Flying	Pilot Monitoring
	[777 Passenger] Set the passenger signs as needed. [777 Freighter] Set the supernumerary signs as needed.
	At or above 10,000 feet MSL, set the LEFT and RIGHT LANDING light switches to ON.
At transition level, set and crosscheck the altimeters.	
Update changes to the arrival and approach procedures as needed. Update changes to the RNP as needed.	
Update the approach briefing as needed.	
Call "APPROACH CHECKLIST."	Do the APPROACH checklist.

Flap Extension Schedule

Current Flap Position	At Speedtape "Display"	Select Flaps	Command Speed for Selected Flaps
UP	"UP"	1	"1"
1	"1"	5	"5"
5	"5"	20	"20"
20	20	25 or 30	(VREF25 or VREF30) + wind additives

Landing Procedure - ILS

Pilot Flying	Pilot Monitoring
	[777 Passenger] Notify the cabin crew to prepare for landing. Verify that the cabin is secure. [777 Freighter] Notify the supernumeraries to prepare for landing.
Call “FLAPS___” according to the flap extension schedule.	Set the flap lever as directed.
When on localizer intercept heading: • verify that the ILS is tuned and identified • verify that the LOC and G/S pointers are shown	
Arm the APP mode.	

[GS Capture NOT Inhibited Before LOC Capture]

WARNING: When using LNAV to intercept the final approach course, LNAV might parallel the localizer without capturing it. The airplane can then descend on the glide slope with the localizer not captured.	
Use HDG SEL/TRK SEL or HDG HOLD /TRK HOLD to intercept the final approach course as needed.	
Verify that the localizer is captured.	
	Call “GLIDE SLOPE ALIVE.”
At glide slope alive, call:	
• “GEAR DOWN” • “FLAPS 20”	
	Set the landing gear lever to DN. Set the flap lever to 20.
Set the speedbrake lever to ARMED.	
At glide slope capture, call “FLAPS___” as needed for landing.	Set the flap lever as directed.

Set the missed approach altitude on the MCP.	
Call “LANDING CHECKLIST.”	Do the LANDING checklist.
At the final approach fix or OM, verify the crossing altitude.	
Monitor the approach.	
Verify the autoland status at 500 feet radio altitude.	

Landing Procedure - Instrument Approach Using VNAV

Use the autopilot during the approach to give:

- autopilot alerts and mode fail indications
- more accurate course and glide path tracking
- lower RNP limits

This procedure is not authorized using QFE.

Pilot Flying	Pilot Monitoring
	[777 Passenger] Notify the cabin crew to prepare for landing. Verify that the cabin is secure. [777 Freighter] Notify the suernumeraries to prepare for landing.
Call “FLAPS __” according to the flap extension schedule.	Set the flap lever as directed.
The recommended roll modes for the final approach are: • for a RNAV or GPS approach use LNAV • for a LOC-BC, VOR, or NDB approach use LNAV • for a LOC, SDF, or LDA approach use LNAV or LOC	
	Verify that the VNAV glide path angle is shown on the final approach segment of the LEGS page.
When on the final approach course intercept heading for LOC, LOC-BC, SDF, or LDA approaches: • verify that the localizer is tuned and identified • verify that the LOC pointer is shown	
Arm the LNAV or LOC mode.	
WARNING: When using LNAV to intercept the localizer, LNAV might parallel the localizer without capturing it. The airplane can then descend on the VNAV path with the localizer not captured.	
Use LNAV, HDG SEL, TRK SEL, HDG HOLD, or TRK HOLD to intercept the final approach course as needed.	

Verify that LNAV is engaged or that the localizer is captured.	
Approximately 2 NM before the final approach fix and after ALT, VNAV PTH, or VNAV ALT is annunciated: • verify that the autopilot is engaged • set DA(H) or MDA(H) on the MCP • select or verify VNAV • select or verify speed intervention	Call “APPROACHING GLIDE PATH.”
Approaching glide path, call: “GEAR DOWN” “FLAPS 20”	Set the landing gear lever to DN. Set the flap lever to 20
Set the SPEEDBRAKE lever to ARMED.	
Beginning the final approach descent, call “FLAPS __” as needed for landing.	Set the flap lever as directed.
Call “LANDING CHECKLIST.”	Do the LANDING checklist.
When at least 300 feet below the missed approach altitude, set the missed approach altitude on the MCP.	
At the final approach fix, verify the crossing altitude and crosscheck the altimeters.	
Monitor the approach.	
If suitable visual reference is established at MDA(H), DA(H), or the missed approach point, disengage the autopilot. Maintain the glide path to landing.	

Go-Around and Missed Approach Procedure

Pilot Flying	Pilot Monitoring
At the same time: • push the TO/GA switch • call “FLAPS 20”	
	Position the flap lever to 20.
Verify: • the rotation to go-around attitude • that the thrust increases	
	Verify that the thrust is sufficient for the go-around or adjust as needed.
	Verify a positive rate of climb on the altimeter and call “POSITIVE RATE.”
Verify a positive rate of climb on the altimeter and call “GEAR UP.”	
	Set the landing gear lever to UP.
Limit bank angle to 15 degrees if airspeed is below minimum maneuver speed.	
Above 400 feet radio altitude, select or verify a roll mode.	Verify that the missed approach altitude is set.
Verify that the missed approach route is tracked.	
At acceleration height, set speed to the maneuver speed for the planned flap setting.	
Call “FLAPS___” according to the flap retraction schedule.	Set the flap lever as directed.
After flap retraction to the planned flap setting, select FLCH or VNAV as needed.	
Verify that climb thrust is set.	
Verify that the missed approach altitude is captured.	

Call “AFTER TAKEOFF CHECKLIST.”	Do the AFTER TAKEOFF checklist.
------------------------------------	---------------------------------

Landing Roll Procedure

Pilot Flying	Pilot Monitoring
Verify that the thrust levers are closed. Verify that the SPEEDBRAKE lever is UP.	Verify that the SPEEDBRAKE lever is UP. Call “SPEEDBRAKES UP.” If the SPEEDBRAKE lever is not UP, call “SPEEDBRAKES NOT UP.”
Monitor the rollout progress.	
Verify correct autobrake operation.	
WARNING: After the reverse thrust levers are raised, a full stop landing must be made. If an engine remains in reverse, safe flight is not possible.	
Without delay, raise the reverse thrust levers to the interlocks and hold light pressure until the interlocks release. Then apply reverse thrust as needed.	
By 60 knots, start movement of the reverse thrust levers reach the reverse idle detent before taxi speed.	Call “60 KNOTS.”
After the engines are at reverse idle, move the reverse thrust levers full down.	
Before taxi speed, disarm the autobrake. Use manual braking as needed.	
Before turning off the runway, disconnect the autopilot.	

[\[Electronic Flight Bag\]](#)

CAUTION: Do not use the Airport Map application as a primary navigation reference. The Airport Map application is designed to aid flight crew positional awareness only.

After Landing Procedure

Start the After Landing Procedure when clear of the active runway.

[PW Engines]

Engine cooldown requirement

- Run the engines for at least 90 seconds
- Use a thrust setting no higher than that normally used for all engine taxi operations

Engine cooldown recommendations:

- Run the engines for at least 5 minutes
- Use a thrust setting no higher than that normally used for all engine taxi operations

[RR Engines]

Engine cooldown recommendations:

- Run the engines for at least 1 minute
- Use a thrust setting no higher than that normally used for all engine taxi operations

[GE Engines]

Engine cooldown recommendations:

- Run the engines for at least 3 minutes
- Use a thrust setting normally used for taxi operations

Pilot Flying	Pilot Monitoring
The Captain positions or verifies that the SPEEDBRAKE lever is DOWN.	
	Set the APU selector to START, then ON, as needed.
	Set the ENGINE ANTI-ICE selectors to ON, if needed.
	Set the exterior lights as needed.
Set the weather radar to off.	
	Set the AUTOBRAKE selector OFF.
	Set the flap lever to UP.

	Set the transponder mode selector as needed. At airports where ground tracking is not available, select STANDBY. At airports equipped to track airplanes on the ground, select an active transponder setting, but not a TCAS mode.
--	--

Shutdown Procedure

Start the Shutdown Procedure after taxi is complete.

Parking brakeSet C or F/O

Verify that the PARKING BRAKE SET message is shown.

Electrical powerSet F/O

If APU power is needed:

Check that the APU RUNNING message is shown.

If external power is needed:

Verify that the PRIMARY EXTERNAL POWER AVAIL light is illuminated.

PRIMARY EXTERNAL POWER switch – Push

Verify that the ON light is illuminated.

If the SECONDARY EXTERNAL POWER AVAIL light is illuminated:

SECONDARY EXTERNAL POWER switch – Push

Verify that the ON light is illuminated.

FUEL CONTROL switchesCUTOFF C

If towing is needed:

Ground handling personnel Establish communications C

WARNING: If the nose gear steering is not locked out, any change to hydraulic power with the tow bar connected may cause unwanted tow bar movement.

Nose gear steering Verify locked out C

CAUTION: Do not hold or turn the nose wheel tiller during pushback or towing. This can damage the nose gear or the tow bar.

CAUTION: Do not use airplane brakes to stop the airplane during pushback or towing. This can damage the nose gear or the tow bar.

Parking brake Set or release C or F/O
Set or release as directed by ground handling personnel.

SEAT BELTS selector OFF F/O

HYDRAULIC panel Set F/O

Note: Depressurize the right system last to prevent fluid transfer between systems.

Center 1, and Center 2 AIR DEMAND pump selectors – OFF

Left ELECTRIC DEMAND pump selector – OFF

Center 1 and Center 2 ELECTRIC PRIMARY pump switches – OFF

Right ELECTRIC DEMAND pump selector – OFF

FUEL PUMP switches OFF F/O

[\[Auxiliary Fuel Tank\]](#)

AUXILIARY FUEL switch OFF F/O

BEACON light switch OFF F/O

FLIGHT DIRECTOR switches OFF C, F/O

Transponder mode selector STBY F/O

[\[Electronic Flight Bag\]](#)

EFB CLOSE FLIGHT Select C, F/O

Status messagesCheck F/O

Note: Disregard EICAS alert and status messages displayed during the PFC self test after hydraulic shutdown. Wait approximately 3 minutes after HYD PRESS SYS L+C+R message is shown before recording status and alert messages in the maintenance log.

After wheel chocks are in place:

Parking brakeRelease C

APU selector As needed F/O

Flight deck door Unlock F/O

Verify that the flight deck door UNLKD light is illuminated.

Call “SHUTDOWN CHECKLIST.” C

Do the SHUTDOWN checklist. F/O

Secure Procedure

ADIRU switch	OFF	F/O
EMERGENCY LIGHTS switch.....	OFF	F/O
PACK switches	OFF	F/O
[Electronic Flight Bag]		
EFB Display	Off	C, F/O
Call “SECURE CHECKLIST.”		C
Do the SECURE checklist.		F/O

Intentionally
Blank

Supplementary Procedures
Table of Contents**Chapter SP**
Section 0

Introduction	SP.05
General	SP.05.1
Airplane General, Emer. Equip., Doors, Windows	SP.1
Doors	SP.1.1
Entry/Service Door Closing	SP.1.1
Entry/Service Door Opening	SP.1.1
Emergency Equipment	SP.1.2
Emergency Oxygen Use	SP.1.2
Flight Deck Door Access System Test	SP.1.2
Air Systems	SP.2
Air Conditioning Packs	SP.2.1
Ground Conditioned Air Use	SP.2.1
Packs Off Takeoff	SP.2.2
APU to Pack Takeoff	SP.2.3
Anti-Ice, Rain	SP.3
Anti-Ice Operation	SP.3.1
Windshield Wiper Use	SP.3.1
Automatic Flight	SP.4
AFDS	SP.4.1
AFDS Operation	SP.4.1
Heading Hold	SP.4.1
Heading Select	SP.4.1
Track Hold	SP.4.2
Track Select	SP.4.2
Altitude Hold	SP.4.2
Flight Level Change, Climb or Descent	SP.4.2
Vertical Speed, Climb or Descent	SP.4.3
Flight Path Angle, Climb or Descent	SP.4.3
Autothrottle Operation	SP.4.4
Instrument Approach Using Vertical Speed (V/S) or Flight Path Angle (FPA)	SP.4.5

Circling Approach	SP.4.6
Communications	SP.5
Flight Deck Communications System (Datalink)	SP.5.1
Pre-Departure Clearance	SP.5.1
Digital-Automatic Terminal Information Service	SP.5.1
Oceanic Clearances	SP.5.1
Weight and Balance	SP.5.1
Takeoff Data	SP.5.1
Electrical	SP.6
Electrical Power Down	SP.6.1
Electrical Power Up	SP.6.2
Engines, APU	SP.7
APU Ground Pneumatic Start	SP.7.1
Engine Battery Start	SP.7.1
Engine Crossbleed Start	SP.7.2
Engine Ground Pneumatic Start	SP.7.2
Manual Engine Start	SP.7.3
Manual Override Engine Start	SP.7.5
Flight Instruments, Displays	SP.10
QFE Operation	SP.10.1
Flight Management, Navigation	SP.11
Departure or Destination Airport Not in the FMC Navigation Database	SP.11.1
Departure Airport Not in the FMC Navigation Database	SP.11.1
Destination Airport Not in the FMC Navigation Database	SP.11.4
ADIRU Alignment/Position Update	SP.11.5
FMS Position Update	SP.11.6
Navaid Inhibit	SP.11.7
RNP Manual Entry	SP.11.8

Fuel	SP.12
Fuel Balancing	SP.12.1
Cold Fuel Operations	SP.12.1
Warning Systems	SP.15
Runway Awareness and Advisory System (RAAS)	
Override Operation	SP.15.1
Adverse Weather	SP.16
Introduction	SP.16.1
Takeoff - Wet or Contaminated Runway Conditions	SP.16.1
Cold Weather Operations	SP.16.2
Exterior Inspection	SP.16.2
Engine Start Procedure	SP.16.3
Engine Anti-ice Operation - On the Ground	SP.16.4
Before Taxi Procedure	SP.16.4
Taxi-Out	SP.16.5
De-icing / Anti-icing	SP.16.6
Before Takeoff Procedure	SP.16.7
Takeoff Procedure	SP.16.8
Engine Anti-ice Operation - In-flight	SP.16.8
Wing Anti-ice Operation - In-flight	SP.16.10
Cold Temperature Altitude Corrections	SP.16.10
After Landing Procedure	SP.16.12
Secure Procedure	SP.16.14
Hot Weather Operation	SP.16.15
Moderate to Heavy Rain, Hail or Sleet	SP.16.15
Severe Turbulence	SP.16.16
Structural Considerations	SP.16.16
Climb, Cruise, and Descent Considerations	SP.16.17
Manual Flight in Severe Turbulence	SP.16.17
Windshear	SP.16.18
Avoidance	SP.16.18
Precautions	SP.16.19
Recovery	SP.16.20

Intentionally
Blank

Supplementary Procedures
Introduction**Chapter SP**
Section 05

General

This chapter contains procedures (adverse weather operation, engine crossbleed start, and so on) that are accomplished as required rather than routinely performed on each flight. Systems tests are described in the System Description chapter of the applicable system.

Note: System tests are not normally a flight crew action.

Procedures accomplished in flight, or those that are an alternate means of accomplishing normal procedures (such as manual engine start), are usually accomplished by memory. Infrequently used procedures, not normally accomplished (such as engine crossbleed start) are usually accomplished by reference.

Supplementary procedures are provided by section. Section titles correspond to the respective chapter title for the system being addressed except for the Adverse Weather section.

Intentionally
Blank

Supplementary Procedures

Chapter SP

Airplane General, Emer. Equip., Doors, Windows

Section 1

Doors

Entry/Service Door Closing

Gust lock latch Release

Door Close

Manually position the door aft and inboard to cover the entry.

Door handle Rotate

Rotate forward 180° to the closed position. The door lowers into position, latches, and locks.

[Option – ARMED/DISARMED Shown, AUTOMATIC/MANUAL Optional]

Mode select lever ARMED

Observe yellow forward and aft girt bar flags are in view.

Entry/Service Door Opening

Mode select lever (interior only)DISARMED

Note: Escape slide/raft and powered door opening is disarmed automatically when the door is opened from outside.

Door handle Rotate

Rotate aft 180° to the open position. The door is lifted clear of the pressure stops.

Door Open

Manually position the door outboard and forward to open. The gust lock latch automatically engages and locks door in the open position.

Emergency Equipment

Emergency Oxygen Use

Emergency oxygen should be used when necessary to provide positive pressure in the masks and goggles to prevent or evacuate contaminants. When positive pressure is not required, but contamination of flight deck air exists, 100% oxygen must be used. If prolonged use is required and the situation permits, oxygen availability should be extended by selecting normal flow. When oxygen use is no longer required, close the left hand oxygen compartment door, then push the RESET/TEST switch to restore normal boom microphone operation.

Flight Deck Door Access System Test

[Passenger - Enhanced security door]

- Flight deck access system switch NORM
- Flight deck doorOpen
- Flight deck door lock selector AUTO
- Emergency access codeEnter
- ENT key Push

Verify alert sounds.

Verify AUTO UNLK light illuminates.

- Flight deck door lock selector DENY

Verify AUTO UNLK light extinguishes.

- Flight deck door lock selector UNLKD

- Flight deck access system switch OFF

Verify LOCK FAIL light illuminates.

- Flight deck access system switch NORM

Guard - Down

Verify LOCK FAIL light extinguishes.

Supplementary Procedures
Air Systems**Chapter SP**
Section 2**Air Conditioning Packs****Ground Conditioned Air Use**

Before connecting ground conditioned air:

PACK switches (both) – OFF

[Prevents pack operation if bleed air is supplied to the airplane.]

RECIRCULATION FANS switches (both) – OFF

[Allows conditioned air unit to operate at maximum efficiency.]

RECIRCULATION FANS switch – OFF

[Allows conditioned air unit to operate at maximum efficiency.]

After disconnecting ground conditioned air:

PACK switches (both) – AUTO

RECIRCULATION FANS switches (both) – ON

RECIRCULATION FANS switch – ON

Packs Off Takeoff

Before takeoff:

PACK switches (both) – OFF

Wait 30 seconds before setting takeoff thrust.

[\[PW or RR Engines\]](#)

[Allows packs to shut down and EECs time to recompute maximum EPR line and reference/target EPR indications.]

[\[GE Engines\]](#)

[Allows packs to shut down and EECs time to recompute maximum N1 line and reference/target N1 indications.]

After takeoff:

PACK switches (both) – AUTO

After engine thrust is reduced from takeoff to climb and prior to reaching 3000 feet above field elevation, position both pack switches to AUTO.

APU to Pack Takeoff

[Standard on 300ER and 200LR; option on all others]

Before start:

PACK switches (both) – AUTO

On the THRUST LIMIT Page, select one of the following takeoff thrust ratings:

- full thrust
- percent derate

[As installed]

- takeoff bump

Enter “APU” into the scratchpad and line select to the “SEL-APU” field. “APU” appears in small font representing the armed mode.

After engine start:

Leave APU running to supply air to the left pack.

Approximately one minute after second engine start, “APU” displays in large font representing the active mode.

Confirm proper configuration by noting a green “A-TO, A-TO1, A-TO2, or A-TOB on EICAS.

Note: If cabin temperature becomes excessive during extended ground operation, establish dual pack operation by deleting the APU selection. To re-establish APU to Pack operation, enter “APU” into the scratchpad and line select to the “SEL-APU” field.

Note: If an engine is shutdown after selecting APU to Pack operation, the engine cannot be started until APU to Pack takeoff mode has been deleted. To re-establish APU to Pack operation after start, re-enter "APU" into the scratchpad and line select to the "SEL-APU" field.

After climb thrust reduction:

APU Selector - Off.

Intentionally
Blank

Supplementary Procedures
Anti-Ice, Rain**Chapter SP**
Section 3

Anti-Ice Operation

Requirements for use of anti-ice and operational procedures for engine and wing anti-ice are contained in Supplementary Procedures, Adverse Weather Section SP.16.

Windshield Wiper Use

CAUTION: Windshield scratching will occur if the windshield wipers are operated on a dry windshield.

Intentionally
Blank

Supplementary Procedures
Automatic Flight**Chapter SP**
Section 4**AFDS****AFDS Operation**

FLIGHT DIRECTOR switchesON
Verify FLT DIR is displayed in the AFDS system status annunciator.

If the autopilot is desired:

AUTOPILOT engage switchPush
Verify A/P is displayed in the AFDS system status annunciator.

Heading Hold

If the airplane is operating in polar regions:

HEADING REFERENCE switch TRUE
HEADING/TRACK reference switchPush
Verify HDG is displayed in the HDG/TRK window.
Heading/track HOLD switchPush
Verify HDG HOLD is displayed in the roll mode annunciator.

Heading Select

Maintains the airplane heading the same as the selected heading.

If the airplane is operating in polar regions:

HEADING REFERENCE switch TRUE
HEADING/TRACK reference switchPush
Verify HDG is displayed in the HDG/TRK window.
Heading/track SELECT switchPush
Verify HDG SEL is displayed in the roll mode annunciator.
Heading/track selector Rotate
Set desired heading in the HDG/TRK window.

Track Hold

If the airplane is operating in polar regions:

HEADING REFERENCE switch TRUE

HEADING/TRACK switch Push
Verify TRK is displayed in the HDG/TRK window.

Heading/track HOLD switch Push
Verify TRK HOLD is displayed in the roll mode annunciator.

Track Select

Maintains the airplane track the same as the selected track.

If the airplane is operating in polar regions:

HEADING REFERENCE switch TRUE

HEADING/TRACK reference switch Push
Verify TRK is displayed in the HDG/TRK window.

Heading/track SELECT switch Push
Verify TRK SEL is displayed in the roll mode annunciator.

Heading/track selector Rotate
Set desired track in the HDG/TRK window.

Altitude Hold

Altitude HOLD switch Push
Verify ALT is displayed in the pitch mode annunciator.

Flight Level Change, Climb or Descent

ALTITUDE selector Rotate
Set the desired altitude in the MCP ALTITUDE window.

FLCH switch Push
Verify FLCH SPD is displayed in the pitch mode annunciator.

IAS/MACH selector Rotate
Set the desired speed in the IAS/MACH window.

Vertical Speed, Climb or Descent

ALTITUDE selector Rotate

Set the desired altitude in the MCP ALTITUDE window.

VERTICAL SPEED/FLIGHT PATH ANGLE reference switch Push

Verify V/S is displayed in the vertical speed/flight path angle window.

VERTICAL SPEED/FLIGHT PATH ANGLE switch Push

Verify V/S is displayed in the pitch mode annunciator.

VERTICAL SPEED/FLIGHT PATH ANGLE selector Rotate

Set the desired vertical speed in the VERTICAL SPEED/FLIGHT PATH ANGLE window.

If a climb is desired:

Select climb thrust limit on the CDU THRUST LIM page.

Flight Path Angle, Climb or Descent

ALTITUDE selector Rotate

Set the desired altitude in the MCP ALTITUDE window.

VERTICAL SPEED/FLIGHT PATH ANGLE Reference switch Push

Verify FPA is displayed in the vertical speed/flight path angle window.

VERTICAL SPEED/FLIGHT PATH ANGLE switch Push

Verify FPA is displayed in the pitch mode annunciator.

VERTICAL SPEED/FLIGHT PATH ANGLE selector Rotate

Set the desired flight path angle in the VERTICAL SPEED/FLIGHT PATH ANGLE window.

If a climb is desired:

Select climb thrust limit on the CDU THRUST LIM page.

Autothrottle Operation

AUTOTHROTTLE ARM switches ARM

If the pitch mode is TO/GA:

TO/GA switch Push

Verify that THR REF is displayed in the autothrottle mode annunciator. THR REF changes to HOLD at 80 knots.

If the pitch mode is ALT, V/S, FPA, G/S, or no pitch mode:

AUTOTHROTTLE switch Push

Verify that SPD is displayed in the autothrottle mode annunciator.

If a constant speed is desired:

IAS/MACH selector Rotate

Set the desired speed in the IAS/MACH window.

If climb or continuous thrust is desired:

CLB CON switch Push

Verify that THR REF is displayed in the autothrottle mode annunciator.

If FLCH or VNAV is desired:

FLCH or VNAV switch Push

Verify that THR REF, THR, SPD, IDLE, or HOLD as appropriate is displayed in the autothrottle mode annunciator.

If TO/GA is desired:

TO/GA switch Push

The pitch mode will change to TO/GA. Verify that THR or THR REF is displayed in the autothrottle mode annunciator.

If the pitch mode is VNAV PTH, VNAV ALT, VNAV SPD, or FLCH SPD:

AUTOTHROTTLE switch Push

Verify THR REF, THR, SPD, IDLE, or HOLD as appropriate is displayed in the autothrottle mode annunciator.

Instrument Approach Using Vertical Speed (V/S) or Flight Path Angle (FPA)

Note: Autopilot use is recommended until suitable visual reference is established.

Note: If required to remain at or above MDA(H) during the missed approach, missed approach must be initiated at least 50 feet above MDA(H).

Recommended roll modes:

- RNAV, GPS, LOC-BC, VOR or NDB approach: LNAV, TRK SEL, or HDG SEL
- LOC, SDF, or LDA approach: LOC or LNAV

Ensure appropriate nav aids (VOR, LOC, or NDB) are tuned and identified prior to commencing the approach.

RNP appropriate for approach (if required) Verify/Enter

Allows appropriate alerting to occur if ANP exceeds RNP.

Before descent to MDA(H):

MCP altitude Set

Set the first intermediate altitude constraint or MDA(H). When the current constraint is assured, the next constraint may be set prior to ALT engaged to achieve continuous descent path.

If constraints or MDA(H) do not end in zero zero (00) (for example, 1820), set MCP ALTITUDE window to the closest 100 foot increment below the constraint or the closest 10 foot increment above the MDA(H).

At descent point:

V/S or FPA switch Push

Verify V/S or FPA mode annunciates.

Desired V/S or FPA Set

Set desired V/S or FPA to descend to MDA(H). Use a V/S or FPA that results in no level flight segment at MDA(H).

Approximately 300 feet above MDA(H):

MCP altitude Set Missed Approach Altitude

At MDA(H)/missed approach point:

If suitable visual reference is not established, execute missed approach.

After suitable visual reference is established:

A/P Disengage switch Push

Disengage autopilot before descending below MDA(H).

Circling Approach

Note: Autopilot use is recommended until intercepting the landing profile.

MCP Altitude selector Set

Accomplish an instrument approach, establish suitable visual reference, and level off at MDA(H).

Verify ALT or VNAV ALT mode annunciates.

MCP Altitude selector Set Missed Approach Altitude

HDG SEL/TRK SEL switch Push

Verify HDG SEL or TRK SEL mode annunciates.

Intercepting the landing profile:

Autopilot disengage switch Push

Supplementary Procedures
Communications**Chapter SP**
Section 5**Flight Deck Communications System (Datalink)**

The following procedures are one means which may be used to verify Pre-Departure Clearance, Digital-Automatic Terminal Information Service, Oceanic Clearances, Weight and Balance and Takeoff Data messages transmitted via the COMPANY format.

Pre-Departure Clearance

The flight crew shall manually verify (compare) the filed flight plan versus the digital pre-departure clearance and shall initiate voice contact with Air Traffic Control if any question/confusion exists between the filed flight plan and the digital pre-departure clearance.

Digital-Automatic Terminal Information Service

The flight crew shall verify that the D-ATIS altimeter setting numeric value and alpha value are identical. If the D-ATIS altimeter setting numeric value and alpha value are different, the flight crew must not accept the D-ATIS altimeter setting.

Oceanic Clearances

The flight crew shall manually verify (compare) the filed flight plan versus the digital oceanic clearance and initiate voice contact with Air Traffic Control if any questions/confusion exists between the filed flight plan and the digital oceanic clearance.

Weight and Balance

The flight crew shall verify that the Weight and Balance numeric and alphabetic values are identical. If the Weight and Balance numeric and alphabetic values are different, the flight crew must not accept the Weight and Balance data.

Takeoff Data

The flight crew shall verify that the Takeoff Data numeric and alphabetic values are identical. If the Takeoff Data numeric and alphabetic values are different, the flight crew must not accept the Takeoff Data message.

Intentionally
Blank

Supplementary Procedures
Electrical

Chapter SP
Section 6

Electrical Power Down

The following procedure is accomplished to remove all electrical power from the airplane.

Before accomplishing the following steps, verify ADIRU, EMER LIGHTS, and PACK switches are off and HYD PRESS SYS L+C+R message is displayed.

APU selector and/or EXTERNAL POWER switch(es) OFF
BATTERY switch OFF

Electrical Power Up

The following procedure is accomplished to permit safe application of electrical power.

- BATTERY switch ON
- C1 and C2 PRIMARY pump switches OFF
- DEMAND pump selectors OFF
- WIPER selectors OFF
- Landing gear lever DN
- ALTERNATE FLAPS selector OFF
- Electrical power Establish

BUS TIE switches – AUTO

If external power is desired:

PRIMARY EXTERNAL POWER AVAIL light – Illuminated

PRIMARY EXTERNAL POWER switch – Push

If the SECONDARY EXTERNAL POWER AVAIL light is illuminated:

SECONDARY EXTERNAL POWER switch – Push

If APU power is desired:

APU GENERATOR switch – ON

APU selector – START, then ON

Supplementary Procedures
Engines, APU**Chapter SP**
Section 7

APU Ground Pneumatic Start

Duct pressure Observe
Observe duct pressure is a minimum of 15 PSI (less 1 PSI per 1000 feet of pressure altitude).

Accomplish normal APU start.

Engine Battery Start

Accomplish the normal Exterior Inspection and the normal Preliminary Preflight Procedure – Captain or First Officer through “Circuit breakers.....Check.”

BATTERY switch ON

C1 and C2 PRIMARY pump switches OFF

DEMAND pump selectors OFF

WIPER selectors OFF

Landing gear lever DN

ALTERNATE FLAPS selector OFF

STANDBY POWER switch
(overhead maintenance panel) Push to BAT, release to AUTO

Center bleed ISOLATION switch OFF

Ground pneumatic source (if available) Connect

If the APU is required for pneumatic power:

APU selector START, then ON

Speedbrake lever Down

Reverse thrust levers Down

Thrust levers Closed

Flap position indication and flap lever Agree

Parking brake Set

FUEL CONTROL switches CUTOFF

Captain's audio control panel Set

Start the left engine using the normal Engine Start procedure. Bleed air is available only to the left engine.

Limit start attempts to one autostart or two manual start attempts.

After left engine is started:

Ground pneumatic source (if used) Disconnect

Center bleed ISOLATION switch AUTO

Complete the normal Preflight, Before Start, and Engine Start procedures.

Engine Crossbleed Start

The APU must be shutdown or the APU Bleed switch must be turned off.

Verify the area behind the airplane is clear of equipment and personnel prior to increasing thrust on operating engine.

Thrust lever (operating engine) Advance

[GE, PW Engines]

Increase thrust until 5% N2 above idle (25 PSI minimum duct pressure).

[RR Engines]

Increase thrust until 5% N3 above idle (25 PSI minimum duct pressure).

Accomplish normal engine start.

Engine Ground Pneumatic Start

Duct pressure Observe

[Observe duct pressure is a minimum of 25 PSI (less 1 PSI per 1000 feet of pressure altitude)].

Accomplish normal engine start.

Manual Engine Start

[RR Engines]

Captain	First Officer
Announce start sequence.	Position AUTOSTART switch to OFF.
Call "START ____ ENGINE."	Position ____ START selector to START.
Observe oil pressure increase.	
Position ____ FUEL CONTROL switch to RUN when: • EGT less than 100 degrees C, and • at maximum motoring, or N3 greater than 25%, whichever occurs first (maximum motoring occurs when N3 acceleration is less than 1% in approximately 5 seconds).	
Observe initial EGT rise and EGT within limits.	
	When engine is stabilized at idle, push AUTOSTART switch ON, if AUTOSTART is available. If more than one engine is to be started manually, AUTOSTART switch may remain OFF between manual starts.

[PW Engines]

Captain	First Officer
Announce start sequence.	Position AUTOSTART switch to OFF.
Call “START ____ ENGINE.”	Position ____ START/IGNITION selector to START.
Observe oil pressure increase.	
Position ____ FUEL CONTROL switch to RUN at maximum motoring, 15% N2 minimum (maximum motoring occurs when N2 acceleration is less than 1% in approximately 5 seconds).	
Observe initial EGT rise and EGT within limits.	
	When engine is stabilized at idle, push AUTOSTART switch ON, if AUTOSTART is available. If more than one engine is to be started manually, AUTOSTART switch may remain OFF between manual starts.

[GE Engines with CON IGN]

Captain	First Officer
Announce start sequence.	Position AUTOSTART switch to OFF.
Call “START ____ ENGINE.”	Position ____ START/IGNITION selector to START.
Observe oil pressure increase.	
Position ____ FUEL CONTROL switch to RUN at maximum motoring (maximum motoring occurs when N2 acceleration is less than 1% in approximately 5 seconds).	
Observe initial EGT rise and EGT within limits.	
	When engine is stabilized at idle, push AUTOSTART switch ON, if AUTOSTART is available. If more than one engine is to be started manually, AUTOSTART switch may remain OFF between manual starts.

Monitor engine displays for start parameters listed below until engine is stabilized at idle:

- Oil pressure should rise before selecting RUN.

[GE, PW Engines]

- EGT should rise within 20 seconds after selecting RUN.

[RR Engines]

- EGT should rise within 30 seconds after selecting RUN.

[GE Engines]

- N1 rotation must be indicated by 50% N2.

[PW Engines]

- N1 rotation must be indicated by 40% N2.

[RR Engines]

- N1 rotation must be indicated by 45% N3.
- EGT must stay within limits.

[GE, PW Engines]

- N2 should reach idle within two minutes after selecting RUN.

[RR Engines]

- N3 should reach idle within two minutes after selecting RUN.

If both engines are to be started manually, the AUTOSTART switch may remain OFF between manual starts.

Repeat procedure to start remaining engine.

Manual Override Engine Start

Start the engine using normal engine start procedure, except direct the ground crew to:

[GE with CON IGN, PW Engines]

- manually open the start valve after positioning START/IGNITION selector to START

[GE with no CON IGN, RR Engines]

- manually open the start valve after positioning START selector to START

[GE Engines]

- manually close the start valve at 62% N2.

[PW Engines]

- manually close the start valve at 42% N2.

[\[RR Engines\]](#)

- manually close the start valve at 50% N3.

Supplementary Procedures
Flight Instruments, Displays

Chapter SP
Section 10

QFE Operation

This procedure is accomplished when ATC altitude assignments are referenced to QFE altimeter settings.

Note: Do not use LNAV and/or VNAV below transition altitude/level.
Altitudes in the navigation database are not referenced to QFE.
Use only raw data for navigation.

CDU APPROACH REF page Select

LANDING REF key Push

Verify QFE selected.

[This sets the landing altitude to zero.]

Altimeters Set

Set altimeters to QFE when below transition altitude/level.

If the QFE altimeter setting is beyond the range of the altimeters, QNH procedures must be used with QNH set in the altimeters.

Intentionally
Blank

Supplementary Procedures
Flight Management, Navigation

Chapter SP
Section 11

Departure or Destination Airport Not in the FMC Navigation Database

When departing from or landing at an airport that is not in the FMC navigation database, the following items are affected:

- Cabin pressurization schedule
- Availability of departure, arrival, and approach procedures in the FMC
- Automatic tuning of VOR, DME, and ILS radios for departure, arrival, and approach procedures
- Format of altitudes and flight levels on the ND and CDU
- Barometric transition altitude alerts (amber display and box) on the PFD

[\[Option - Landing Altitude Reference Bar\]](#)

- Landing altitude reference bar (white/amber bar) on the PFD altitude tape
- Landing altitude indication (amber crosshatched area) on the PFD altitude tape.

Use the following procedures when departing from or landing at an airport that is not in the FMC navigation database.

Departure Airport Not in the FMC Navigation Database

CDU Preflight Procedure - Captain and First Officer

RTE key Select

If ORIGIN contains an ICAO identifier:

The following steps clear the ORIGIN and erase the previous route.

INIT REF key Select

INDEX Select

IDENT Select

Inactive date range Select

ACTIVE date range Select

Transfers the inactive navigation database to the ACTIVE line
and removes the previously entered route.

Clear the NAV DATA OUT OF DATE scratchpad message.

Inactive date range Select

ACTIVE date range Select

Transfers the inactive navigation database to the ACTIVE line.

Verify that the ACTIVE date range is current.

RTE key Select

Leave ORIGIN blank.

DESTEnter

RouteEnter

LEGS key Select

Enter the latitude and longitude of the departure airport as the first
waypoint on the route.

ACTIVATE and execute the route.

VNAV key Select

Shows the CLB page.

TRANS ALTEnter

NAV RAD key Select

Departure navaid frequency and CRS (as needed)Enter

LDG ALT selector Pull

Rotate to set the departure airport altitude manually. This reduces crew workload in the event of a return to the departure airport.

Do not accomplish the following checklist:

LANDING ALTITUDE

After engine start, override the LANDING ALTITUDE checklist.

Note: The LDG ALT flag is shown on the PFD.

[\[Option - Landing Altitude Reference Bar\]](#)

Note: The landing altitude reference bar (white/amber bar) is not shown on the PFD altitude tape.

Note: The landing altitude indication (amber crosshatched area) is not shown on the PFD altitude tape.

When no longer needed, delete the departure navaid frequency and CRS.

Before Descent

LDG ALT selector Push

The FMC sets the destination altitude automatically.

VNAV key Select

NEXT PAGE key Select

FORECAST Select

Shows the DESCENT FORECAST page.

TRANS LVL Enter

Overwrites the manually entered departure airport transition altitude.

Destination Airport Not in the FMC Navigation Database

CDU Preflight Procedure - Captain and First Officer

The following steps can also be done in flight.

LEGS key Select

Enter the latitude and longitude of the destination airport as the final waypoint on the route.

Enter a speed/altitude constraint for the final waypoint. The speed constraint should be the planned approach speed and the altitude constraint should be the destination airport elevation.

ACTIVATE (if needed) and execute the route.

Before Descent

VNAV key Select

NEXT PAGE key Select

FORECAST Select

Shows the DESCENT FORECAST page.

TRANS LVLEnter

LDG ALT selectorPull

Rotate to set the destination airport altitude manually.

Do not accomplish the following checklist:

LANDING ALTITUDE

Override the LANDING ALTITUDE checklist.

Note: The LDG ALT flag is shown on the PFD.

[\[Option - Landing Altitude Reference Bar\]](#)

Note: The landing altitude reference bar (white/amber bar) is not shown on the PFD altitude tape during approach.

Note: The landing altitude indication (amber crosshatched area) is not shown on the PFD latitude tape during landing.

Note: The ARRIVALS page is not available for the destination airport.

Before Approach

NAV RAD key Select
Destination navaid frequency and CRS (as needed) Enter
ND mode selector As needed
Select APP, VOR or MAP based on the type of approach to be flown.

[Option - Enhanced FIX Pages]

Note: To create a reference on the ND map, on the FIX INFO page, enter the latitude and longitude of the runway threshold and enter the reciprocal of the final approach course as a bearing. This creates a dashed green line, aligned with the final approach course on the ND map.

ADIRU Alignment/Position Update

If an ADIRU position update is desired during an automatic realignment (on ground only):

CDU – SET

When dash prompts appear on the SET INERTIAL POS line of the POS INIT page, enter the most accurate position.

If a manual ADIRU alignment is desired (on ground only):

ADIRU switch – OFF 30 seconds, then ON

Wait an additional 30 seconds.

CDU – SET

Enter the most accurate position in the boxes on the SET INERTIAL POS line of the POS INIT page.

Alignment requires from six to fifteen minutes depending on latitude (six minutes at the equator, ten minutes average).

FMS Position Update

When the FMC message VERIFY POSITION is displayed, the FMC position may require updating.

POS REF page 2/3 Select
POS REF 2/3 is the second page of POS INIT 1/3.

Compare the FMS positions with the displayed GPS, RADIO, and INERTIAL positions.

Select the most appropriate source for FMC position updating.

UPDATE ARM key Select
The ARM prompt changes to ARMED and NOW prompts appear to the right of the remaining position sources.

Appropriate source UPDATE NOW key Push

Navaid Inhibit

Note: GPS position updates should be used during all approaches in which the FMC database and approach procedures are referenced to the WGS-84 reference datum. GPS updates should be inhibited for other approach operations not based on WGS-84 unless other appropriate procedures are used. GPS position updates should be used for all other operations unless a specific state requires the use of other update provisions within their airspace (eg, to accommodate a non-WGS reference datum or other reason).

To inhibit GPS:

POS REF page 3/3 Select
 POS REF 3/3 is the third page of POS INIT 1/3.

GPS NAV key Push
 Verify OFF displays in large font.

To inhibit VORs, VOR/DMEs, VORTACs, or DMEs:

INIT REF key Push

INDEX key Push

NAV DATA key Push

To enable/disable radio updating:

Note: The default state of RAD NAV INHIBIT is ON; all radio updating is inhibited. “ON” displays.

RAD NAV INHIBIT key Push

First “push” enables all radio updating. Verify OFF.

Second “push” inhibits VOR/DME updating. Verify VOR.

DME/DME updating is operable.

Subsequent “push” inhibits all radio updating; ON displays.

RNP Manual Entry

The FMC automatically supplies default RNP values based on phase of flight. When the airplane is on a procedure or airway that has an RNP requirement, and does not have an RNP value stored in the navigation database, a manual RNP entry may be made.

POS REF page 2/3 Select
POS REF 2/3 is the second page of POS INIT 1/3.

If the displayed RNP is different from the RNP for the current airway or procedure:

RNPEnter

When the manually entered RNP is no longer required:

POS REF page 2/3 Select
RNPDelete

Supplementary Procedures
Fuel**Chapter SP**
Section 12

Fuel Balancing

If fuel leak is suspected:

Accomplish the FUEL LEAK checklist.

If fuel balancing is desired prior to display of the FUEL IMBALANCE alert message, accomplish the FUEL IMBALANCE non-normal checklist.

Cold Fuel Operations**[RR Engines]**

CAUTION: Do not do this procedure and balance fuel at the same time. Balance fuel before or after doing the procedure.

Within 2 hours of top of descent (TD), but not less than 15 minutes before top of descent (TD), check fuel temperature.

If fuel temperature is colder than -10 degrees C:

Do one of the following:

- (1) Perform a step climb using maximum climb thrust (VNAV preferred), or
- (2) Select or verify CLB thrust on the thrust limit page and verify cruise speed is set to 0.84 Mach or less. Then,
 - manually advance thrust levers to maximum (autothrottles may be overridden). After reaching maximum climb thrust, hold for 10 seconds or until reaching 0.86 Mach, whichever occurs first,
 - check engines have achieved maximum climb thrust and respond normally,
 - retard thrust levers to cruise power and resume normal operations.

If fuel temperature is -10 degrees C or warmer, no crew action required.

Intentionally
Blank

Supplementary Procedures
Warning Systems**Chapter SP**
Section 15**Runway Awareness and Advisory System (RAAS) Override Operation****[Option - With Runway Awareness and Advisory System]**

If one or more of the following exist:

- The airport is not in the GPWS database
- A NOTAM applies to the intended runway
- Airline policy prohibits the use of RAAS for an airport or runway.

GROUND PROXIMITY RUNWAY OVERRIDE switch OVRD

Intentionally
Blank

Supplementary Procedures
Adverse Weather**Chapter SP**
Section 16**Introduction**

Airplane operation in adverse weather conditions may require additional considerations due to the effects of extreme temperatures, precipitation, turbulence, and windshear. Procedures in this section supplement normal procedures and should be observed when applicable.

Takeoff - Wet or Contaminated Runway Conditions

The following information applies to takeoffs on wet or contaminated runways:

[[Option - Airplanes with fixed derate option.](#)]

- For wet runways, reduced thrust (fixed derate, assumed temperature method, or both) is allowed provided suitable takeoff performance accountability is made for the increased stopping distance on a wet surface
- For runways contaminated by slush, snow, standing water, or ice, reduced thrust (fixed derate) is allowed provided takeoff performance accounts for the runway surface condition. Reduced thrust using assumed temperature method, whether alone or in combination with a fixed derate, is not allowed
- V1 may be reduced to minimum V1 to provide increased stopping margin provided the field length required for a continued takeoff from the minimum V1 and obstacle clearance meet the regulatory requirements. The determination of such minimum V1 may require a real-time performance calculation tool or other performance information supplied by dispatch
- Takeoffs are not recommended when slush, wet snow, or standing water depth is more than 1/2 inch (13 mm) or dry snow depth is more than 4 inches (102 mm).

Cold Weather Operations

Considerations associated with cold weather operation are primarily concerned with low temperatures and with ice, snow, slush, and standing water on the airplane, ramps, taxiways, and runways.

Icing conditions exist when OAT (on the ground) or TAT (in-flight) is 10°C or below and any of the following exists:

- visible moisture (clouds, fog with visibility of one statute mile (1600 m) or less, rain, snow, sleet, ice crystals, and so on) is present, or
- ice, snow, slush, or standing water is present on the ramps, taxiways, or runways.

CAUTION: Do not use engine anti-ice when OAT (on the ground) is above 10°C. Do not use engine or wing anti-ice when TAT (in-flight) is above 10°C.

Exterior Inspection

Although removal of surface snow, ice and frost is normally a maintenance function, during preflight procedures, the captain or first officer should carefully inspect areas where surface snow, ice or frost could change or affect normal system operations.

Do the normal Exterior Inspection with the following additional steps:

Surfaces Check

Takeoff with light coatings of frost, up to 1/8 inch (3mm) in thickness, on lower wing surfaces due to cold fuel is allowable; however, all leading edge devices, all control surfaces, and upper wing surfaces must be free of snow, ice and frost.

Thin hoarfrost is acceptable on the upper surface of the fuselage provided all vents and ports are clear. Thin hoarfrost is a uniform white deposit of fine crystalline texture, which usually occurs on exposed surfaces on a cold and cloudless night, and which is thin enough to distinguish surface features underneath, such as paint lines, markings or lettering.

Pitot probes and static ports Check

Verify that all pitot probes and static ports are free of snow and ice. Water rundown after snow removal may freeze immediately forward of static ports and cause an ice buildup which disturbs airflow over the static ports resulting in erroneous static readings even when static ports are clear.

Air conditioning inlets and exits Check

Verify that the air inlets and exits, including the outflow valves, are free of snow and ice.

Engine inlets Check

Verify that the inlet cowling is free of snow and ice.

Fuel tank vents Check

Verify that all traces of ice and frost are removed.

Landing gear doors Check

Landing gear doors should be free of snow and ice.

APU air inlets Check

The APU inlet door must be free of snow and ice before APU start.

Engine Start Procedure

Do the normal Engine Start Procedure with the following considerations:

- Oil pressure may be slow to rise
- Initial oil pressure rise may be higher than normal
- Additional warm-up time may be needed to allow oil temperature to reach the normal range.
- Displays may require additional warm-up time before displayed engine indications accurately show changing values. Displays may appear less bright than normal.

Engine Anti-ice Operation - On the Ground

Engine anti-ice must be selected ON immediately after both engines are started and remain on during all ground operations when icing conditions exist or are anticipated, except when the temperature is below -40°C OAT.

WARNING: Do not rely on airframe visual icing cues before activating engine anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

CAUTION: Do not use engine anti-ice when OAT is above 10°C .

When engine anti-ice is needed:

ENGINE ANTI-ICE selectors ON F/O

When engine anti-ice is no longer needed:

ENGINE ANTI-ICE selectors AUTO F/O

Before Taxi Procedure

Do the normal Before Taxi Procedure with the following modifications:

If taxi route is through ice, snow, slush or standing water in low temperatures or if precipitation is falling with temperatures below freezing, taxi out with the flaps up. Taxiing with the flaps extended subjects the flaps and flap drives to contamination. Leading edge devices are also susceptible to slush accumulations.

Call “FLAPS ____” as needed. C

Flap lever Set flaps, as needed F/O

Taxi-Out

CAUTION: Taxi at a reduced speed. Use smaller tiller and rudder inputs, and apply minimum thrust evenly and smoothly. Taxiing on slippery taxiways or runways at excessive speed or with high crosswinds may start a skid.

When engine anti-ice is required and the OAT is 3°C or below, do an engine run up, as needed, to minimize ice build-up. Use the following procedure:

C

Check that the area behind the airplane is clear.

[PW Engines and GE Engines except 110B/115B]

Run-up to a minimum of 50% N1 for approximately 1 second duration at intervals no greater than 15 minutes.

[RR Engines and GE 110B/115B engines]

Run-up to a minimum of 50% N1 for approximately 1 second duration at intervals no greater than 60 minutes.

De-icing / Anti-icing

Testing of undiluted de-icing/anti-icing fluids has shown that some of the fluid remains on the wing during takeoff rotation and initial climb. The residual fluid causes a temporary decrease in lift and increase in drag, however, the effects are temporary. Use the normal takeoff rotation rate.

CAUTION: Operate the APU during de-icing only if necessary. If the APU is running, ingestion of de-icing fluid causes objectionable fumes and odors to enter the airplane. Ingestion of snow, slush, ice, or de-icing/anti-icing fluid can also cause damage to the APU.

If de-icing / anti-icing is needed:

APU As needed F/O

The APU should be shut down unless APU operation is necessary.

Call “FLAPS UP”. C

Flaps UP F/O

Prevents ice and slush from accumulating in flap cavities during de-icing.

Thrust levers Idle C

Reduces the possibility of injury to personnel at inlet or exhaust areas.

PACK switches OFF

Wait approximately 10 seconds after pack switches are off before positioning bleed switches to off to reduce pack wear.

ENGINE bleed switches (engines running) OFF F/O

Reduces the possibility of fumes entering the air conditioning system.

APU bleed switch (APU running) OFF F/O

Reduces the possibility of fumes entering the air conditioning system.

After de-icing / anti-icing is completed:

APU As needed F/O

Wait approximately one minute after de-icing is completed to restore engine and APU bleed air and pack operation to ensure all de-icing fluid has been cleared from the engines:

PACK switches AUTO F/O

ENGINE bleed switches ON F/O

APU bleed switch AUTO F/O

Before Takeoff Procedure

Do the normal Before Takeoff Procedure with the following modification:

Call "FLAPS __" as needed for takeoff. PF

Flap lever Set takeoff flaps, as needed PM

Extend the flaps to the takeoff setting at this time if they have been held because of slush, standing water, or icing conditions, or because exterior de-icing / anti-icing.

[PW, RR engines]

Engine oil temperature Minimum 50°C PF

[RR engines]

Oil temperature must be at least 50°C before takeoff.

[PW engines]

Oil temperature must be at least 50°C before takeoff. Any subsequent drop in oil temperature will not affect engine performance.

Takeoff Procedure

Do the normal Takeoff Procedure with the following modification:

When engine anti-ice is required and the OAT is 3°C or below, the takeoff must be preceded by a static engine run-up. Use the following procedure:

[PW, RR engines]

Run-up to a minimum of 50% N1 and confirm stable engine operation before the start of the takeoff roll.

[GE engines]

Run-up to as high a thrust setting as practical and confirm stable engine operation before the start of the takeoff roll.

Engine Anti-ice Operation - In-flight

Engine anti-ice must be AUTO or ON during all flight operations when icing conditions exist or are anticipated, except when the temperature is below -40°C SAT.

CAUTION: Do not use engine anti-ice when TAT is above 10°C.

Manual Use of Engine Anti-ice

When using the engine anti-ice system manually in areas of possible icing, activate engine anti-ice before entering icing conditions.

WARNING: If using the engine anti-ice system manually, do not rely on airframe visual icing cues before activating engine anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

When manual use of engine anti-ice is needed:

ENGINE ANTI-ICE selectors ON PM

When manual use of engine anti-ice is no longer needed:

ENGINE ANTI-ICE selectors AUTO or OFF PM

Fan Ice Removal

CAUTION: Avoid prolonged operation in moderate to severe icing conditions.

If moderate to severe icing conditions are encountered:

[\[GE engines\]](#)

During flight in moderate to severe icing conditions for prolonged periods with N1 settings at or below 70%, or when fan icing is suspected due to high engine vibration, the fan blades must be cleared of any ice. Do the following procedure every 15 minutes on both engines, one engine at a time: reduce thrust toward idle then increase to a minimum of 70% N1 for 10 to 30 seconds.

[\[GE 110B, GE 115B engines\]](#)

Note: Operation in icing conditions may result in displayed vibration levels up to and exceeding the normal operating range. Extended operation at high vibration levels in icing conditions will not result in engine damage.

[\[PW engines\]](#)

During flight in moderate to severe icing conditions for prolonged periods with N1 settings at or below 70% and when fan icing is suspected due to high engine vibration, the fan blades must be cleared of any ice. Do the following procedure on both engines, one engine at a time: reduce thrust toward idle then increase to a minimum of 70% N1 for 15 seconds. Repeat this procedure as required to avoid high vibration.

[\[RR engines\]](#)

During flight in moderate to severe icing conditions for prolonged periods, if fan icing is suspected due to high engine vibration, the fan blades must be cleared of any ice. Do the following procedure on both engines, one engine at a time: quickly reduce thrust to idle for 5 seconds then restore the required thrust. If vibration persists, advance thrust lever to 90% N1 momentarily.

Wing Anti-ice Operation - In-flight

Ice accumulation on the flight deck window frames, windshield center post, or windshield wiper arm, or side windows may be used as an indication of structural icing conditions and the need to turn on wing anti-ice.

The wing anti-ice system may be used as a de-icer or anti-icer in flight only. The primary method is to use the automatic ice detection system which acts as a de-icer by allowing ice to accumulate before turning wing anti-ice on. This procedure provides the cleanest airfoil surface, the least possible runback ice formation, and the least thrust and fuel penalty.

The secondary method is to select the WING ANTI-ICE selector ON when wing icing is possible and use the system as an anti-icer.

The airplane is capable of continued safe flight and landing in icing conditions in the event of an in-flight failure of the wing anti-ice system.

CAUTION: Do not use wing anti-ice when TAT is above 10°C.

Manual Use of Wing Anti-ice

When manual use of wing anti-ice is needed:

WING ANTI-ICE switch ON PM

When manual use of wing anti-ice is no longer needed:

WING ANTI-ICE switch AUTO or OFF PM

Cold Temperature Altitude Corrections

Extremely low temperatures create significant altimeter errors and greater potential for reduced terrain clearance. When the temperature is colder than ISA, true altitude will be lower than indicated altitude. Altimeter errors become significantly larger when the surface temperature approaches -30°C or colder, and also become larger with increasing height above the altimeter reference source.

Apply the altitude correction table when needed:

- no corrections are needed for reported temperatures above 0°C or if the airport temperature is at or above the minimum published temperature for the procedure being flown.
- do not correct altimeter barometric reference settings
- ATC assigned altitudes or flight levels should not be adjusted for temperature when under radar control

- corrections apply to QNH and QFE operations
- apply corrections to all published minimum departure, en route and approach altitudes, including missed approach altitudes, according to the table below 1. Advise ATC of the corrections
- MDA/DA settings should be set at the corrected minimum altitudes for the approach
- subtract the elevation of the altimeter barometric reference setting source (normally the departure or destination airport elevation) from published minimum altitude to be flown to determine “height above altimeter reference source”
- enter the table with Airport Temperature and with “height above altimeter reference source.” Read the correction where these two entries intersect. Add the correction to the published minimum altitude to be flown to determine the corrected indicated altitude to be flown. To correct an altitude above the altitude in the last column, use linear extrapolation (e.g., to correct 6000 feet or 1800 meters, use twice the correction for 3000 feet or 900 meters, respectively). The corrected altitude must always be greater than the published minimum altitude.
- if the corrected indicated altitude to be flown is between 100 foot increments, set the MCP altitude to the closest 100 foot increment above the corrected indicated altitude to be flown.

Altitude Correction Table (Heights and Altitudes in Feet)

Airport Temp °C	Height Above Altimeter Reference Source											
	200 feet	300 feet	400 feet	500 feet	600 feet	700 feet	800 feet	900 feet	1000 feet	1500 feet	2000 feet	3000 feet
0°	20	20	30	30	40	40	50	50	60	90	120	170
-10°	20	30	40	50	60	70	80	90	100	150	200	290
-20°	30	50	60	70	90	100	120	130	140	210	280	420
-30°	40	60	80	100	120	140	150	170	190	280	380	570
-40°	50	80	100	120	150	170	190	220	240	360	480	720
-50°	60	90	120	150	180	210	240	270	300	450	590	890

Altitude Correction Table (Heights and Altitudes in Meters)

Airport Temp °C	Height Above Altimeter Reference Source											
	60	90	120	150	180	210	240	270	300	450	600	900
	MTRS	MTRS	MTRS	MTRS	MTRS	MTRS	MTRS	MTRS	MTRS	MTRS	MTRS	MTRS
0°	5	5	10	10	10	15	15	15	20	25	35	50
-10°	10	10	15	15	20	20	25	30	30	45	60	90
-20°	10	15	20	25	25	30	35	40	45	65	85	130
-30°	15	20	25	30	35	40	45	55	60	85	115	170
-40°	15	25	30	40	45	50	60	65	75	110	145	220
-50°	20	30	40	45	55	65	75	80	90	135	180	270

After Landing Procedure

CAUTION: Taxi at a reduced speed. Use smaller tiller and rudder inputs, and apply minimum thrust evenly and smoothly. Taxiing on slippery taxiways or runways at excessive speed or with high crosswinds may start a skid.

Do the normal After Landing Procedure with the following modifications:

After prolonged operation in icing conditions with the flaps extended, or when an accumulation of airframe ice is observed, or when operating on a runway or taxiway contaminated with ice, snow, slush or standing water:

Do not retract the flaps until the flap areas have been checked to be free of contaminants.

Engine anti-ice must be selected ON and remain on during all ground operations when icing conditions exist or are anticipated, except when the temperature is below -40°C OAT.

WARNING: Do not rely on airframe visual icing cues before activating engine anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

CAUTION: Do not use engine anti-ice when OAT is above 10°C.

When engine anti-ice is needed:

ENGINE ANTI-ICE selectorsON F/O

When engine anti-ice is no longer needed:

ENGINE ANTI-ICE selectors AUTO F/O

When engine anti-ice is required and the OAT is 3°C or below, do an engine run up, as needed, to minimize ice build-up. Use the following procedure: C

Check that the area behind the airplane is clear.

[PW Engines and GE Engines except 110B/115B]

Run-up to a minimum of 50% N1 for approximately 1 second duration at intervals no greater than 15 minutes.

[RR Engines and GE 110B/115B engines]

Run-up to a minimum of 50% N1 for approximately 1 second duration at intervals no greater than 60 minutes.

Secure Procedure

Do the normal Secure Procedure with the following modifications:

If the airplane will be attended:

PACK switchesAUTO F/O

If the airplane will not be attended, or if staying overnight at off-line stations or at airports where normal support is not available, the flight crew must arrange for or verify that the following steps are done:

OUTFLOW VALVE switchesMAN F/O

OUTFLOW VALVE MANUAL switches CLOSE F/O

Position the outflow valves fully closed to inhibit the intake of snow or ice.

Wheel chocks Verify in place C or F/O

Parking brakeReleased C

Reduces the possibility of frozen brakes.

Cold weather maintenance procedures for securing the airplane may be required. These procedures are found in the approved Aircraft Maintenance Manual.

Hot Weather Operation

During extended ground operations prior to flight deck preparation, consideration should be given to reducing the heat being generated on the flight deck. Window heat, radar, and other electronic components which contribute to a high temperature level on the flight deck may be turned off. All the flight deck air outlets should be open.

[777 Passenger]

Both packs should be used (when possible) for maximum cooling. Recirculation fans should be on for maximum cooling capacity. To maximize the cooling capacity of the air conditioning system, the flight deck side windows and all doors, including cargo doors, should be kept closed as much as possible. All gasper outlets should be open and window shades on the hot (sun-exposed) side of the passenger cabin should be closed. Flight deck cooling can be improved by closing the flight deck door and lowering the side trays adjacent to the pilot seats.

[777 Freighter]

Both packs should be used (when possible) for maximum cooling. Recirculation fans should be on for maximum cooling capacity. To maximize the cooling capacity of the air conditioning system, the flight deck side windows and all doors, including cargo doors, should be kept closed as much as possible. Flight deck cooling can be improved by lowering the side trays adjacent to the pilot seats.

Note: If only cooling air from ground air conditioning cart is supplied (no pressurized air from the APU or ground external air), then the TAT probe is not aspirated. Because of high TAT probe temperatures, the FMCs may not accept an assumed temperature derate. Delay selecting an assumed temperature derate until after bleed air is available.

Moderate to Heavy Rain, Hail or Sleet

Flight should be conducted to avoid thunderstorms, hail activity or visible moisture over storm cells. To the maximum extent possible, moderate to heavy rain, hail or sleet should be avoided.

Severe Turbulence

The turbulent air penetration speed provides ample protection from stall and high speed buffet, while also providing protection from exceeding the structural limit.

The recommended procedures for flight in severe turbulence are summarized below:

[777 Passenger]

Passenger signs ON

Advise passengers to fasten seatbelts prior to entering areas of reported or anticipated turbulence. Instruct flight attendants to check all passengers’ seat belts are fastened.

[777 Freighter]

Supernumerary signs ON

Advise supernumeraries to fasten seatbelts prior to entering areas of reported or anticipated turbulence.

Structural Considerations

Flap extension in an area of known turbulence should be delayed as long as possible because the airplane can withstand higher gust loads in the clean configuration. Diversion to another airfield is recommended if severe turbulence persists in the area.

Climb, Cruise, and Descent Considerations

After takeoff, and when established in a clean climb configuration, use of the autoflight system is recommended for flight through turbulence.

During climb and descent, use of VNAV or flight level change may result in excessive pitch changes as the AFDS attempts to fly speed with the elevators. Therefore, vertical speed mode (speed on autothrottles) is recommended for climb and descent in severe turbulence.

During cruise, VNAV and altitude hold modes both fly speed on autothrottles and can be used in turbulence.

[PW or RR Engines]

In severe turbulence during cruise, it may be necessary to disconnect the autothrottles to prevent excessive thrust changes. Thrust setting guidance is available on EICAS when VNAV is engaged. Set EPR at or slightly above the magenta VNAV target EPR indication. Change thrust setting only if required to modify an unacceptable speed trend.

[GE Engines]

In severe turbulence during cruise, it may be necessary to disconnect the autothrottles to prevent excessive thrust changes. Thrust setting guidance is available on EICAS when VNAV is engaged. Set N1 at or slightly above the magenta VNAV target N1 indication. Change thrust setting only if required to modify an unacceptable speed trend.

Manual Flight in Severe Turbulence

If manual flight in severe turbulence becomes necessary, trim the airplane for the turbulent air penetration speed. Control the airplane pitch attitude with the elevators using the attitude indicator as the primary instrument. In extreme drafts, large altitude changes may occur. Do not make sudden large control inputs. Corrective actions to regain the desired attitude should be smooth and deliberate. Altitude variations are likely in severe turbulence and should be allowed to occur if terrain clearance is adequate. Control airplane attitude first, then make corrections for airspeed, altitude, and heading.

Windshear

Windshear is a change of wind speed and/or direction over a short distance along the flight path. Indications of windshear are listed in the Non-Normal Maneuvers section in this manual.

Avoidance

The flight crew should search for any clues to the presence of windshear along the intended flight path. Presence of windshear may be indicated by:

- Thunderstorm activity
- Virga (rain that evaporates before reaching the ground)
- Pilot reports
- Low level windshear alerting (LLWAS) warnings

Stay clear of thunderstorm cells and heavy precipitation and areas of known windshear. If the presence of windshear is confirmed, delay takeoff or do not continue an approach.

Precautions

If windshear is suspected, be alert to any of the danger signals and be prepared for the possibility of an inadvertent encounter. The following precautionary actions are recommended if windshear is suspected:

Takeoff

- Use maximum takeoff thrust instead of reduced thrust.
- For optimum takeoff performance, use flaps 20 for takeoff unless limited by obstacle clearance and/or climb gradient. Flaps 15 may be used as a precautionary setting and will provide nearly equivalent performance to Flaps 20.
- Use the longest suitable runway provided it is clear of areas of known windshear.
- Use the flight director after takeoff.
- Consider increasing V_r speed to the performance limited gross weight rotation speed, not to exceed actual gross weight V_r+20 knots. Set V speeds for the actual gross weight. Rotate at the adjusted (higher) rotation speed. This increased rotation speed results in an increased stall margin, and meets takeoff performance requirements. If windshear is encountered at or beyond the actual gross weight V_r , do not attempt to accelerate to the increased V_r , but rotate without hesitation.
- Be alert for any airspeed fluctuations during takeoff and initial climb. Such fluctuations may be the first indication of windshear.
- Know the all-engine initial climb pitch attitude. Rotate at the normal rate to this attitude for all non-engine failure takeoffs. Minimize reductions from the initial climb pitch attitude until terrain and obstruction clearance is assured, unless stick shaker activates.
- Crew coordination and awareness are very important. Develop an awareness of normal values of airspeed, attitude, vertical speed and airspeed build-up. Closely monitor vertical flight path instruments such as vertical speed and altimeters. The pilot monitoring should be especially aware of vertical path instruments and call out any deviations from normal.
- Should airspeed fall below the trim airspeed, unusual control column forces may be required to maintain the desired pitch attitude. Stick shaker must be respected at all times.

Approach and Landing

- Use either Flaps 25 or 30 for landing.
- Establish a stabilized approach no lower than 1000 feet above the airport to improve windshear recognition capability.

- Use the most suitable runway that avoids the areas of suspected windshear and is compatible with the crosswind or tailwind limitations. Use ILS G/S, VNAV path or VASI/PAPI indications to detect flight path deviations and help with timely detection of windshear.
- If the autothrottle is disengaged, or is planned to be disengaged prior to landing, add an appropriate airspeed correction (correction applied in the same manner as gust), up to a maximum of 20 knots.
- Avoid large thrust reductions or trim changes in response to sudden airspeed increases as these may be followed by airspeed decreases.
- Crosscheck flight director commands using vertical flight path instruments.
- Crew coordination and awareness are very important, particularly at night or in marginal weather conditions. Closely monitor the vertical flight path instruments such as vertical speed, altimeters and glide slope displacement. The pilot monitoring should call out any deviations from normal. Use of autopilot and autothrottle for the approach may provide more monitoring and recognition time.

Recovery

Accomplish the WINDSHEAR ESCAPE MANEUVER found in the Non-Normal Maneuvers section of this manual.

Performance Dispatch

Chapter PD

Table of Contents

777-200 GE90-76B KG JAA	----- PD.10.1
777-200ER TRENT892 KG FAA	----- PD.20.1
777-200LR GE90-110B1L KG FAA	----- PD.30.1
777F GE90-110B1L KG JAA	----- PD.40.1
777-300 PW4090 LB FAA	----- PD.50.1
777-300ER GE90-115BL LB FAA	----- PD.60.1

Intentionally
Blank

Performance Dispatch**Chapter PD****Table of Contents****Section 10****777-200 GE90-76B KG JAA****Takeoff..... PD.10.1**

Takeoff Field Corrections - Dry RunwayPD.10.1

Takeoff Field & Climb Limit Weights - Dry RunwayPD.10.2

Takeoff Field Corrections - Wet RunwayPD.10.4

Takeoff Field & Climb Limit Weights - Wet RunwayPD.10.5

Takeoff Obstacle Limit Weight.....PD.10.7

Takeoff Speeds - Dry RunwayPD.10.8

Takeoff Speeds - Wet RunwayPD.10.9

Enroute PD.11.1

Long Range Cruise Maximum Operating AltitudePD.11.1

Long Range Cruise Trip Fuel and TimePD.11.3

Long Range Cruise Step Climb Trip Fuel and TimePD.11.5

Short Trip Fuel and TimePD.11.6

Holding PlanningPD.11.7

Crew Oxygen Requirements.....PD.11.8

Net Level Off WeightPD.11.10

Long Range Cruise Critical Fuel Reserves.....PD.11.11

Landing PD.12.1

Landing Field Limit WeightPD.12.1

Landing Climb Limit WeightPD.12.2

Go-Around Climb GradientPD.12.3

Quick Turnaround Limit Weight.....PD.12.4

Gear Down..... PD.13.1

Takeoff/Landing Climb Limit WeightPD.13.1

Takeoff Obstacle Limit Weight.....PD.13.2

Long Range Cruise Altitude CapabilityPD.13.3

Long Range Cruise Trip Fuel and TimePD.13.4

Short Trip Fuel and Time	PD.13.6
Holding Planning	PD.13.7
Net Level Off Weight	PD.13.8
Text.....	PD.14.1
Introduction	PD.14.1
Takeoff	PD.14.1
Enroute	PD.14.4
Landing	PD.14.7
Gear Down	PD.14.8

Performance Dispatch**Chapter PD****Takeoff****Section 10****Takeoff Field Corrections - Dry Runway****Slope Corrections**

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH(M)								
	RUNWAY SLOPE (%)								
	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
1200	1210	1210	1210	1200	1200	1180	1150	1130	1100
1400	1430	1430	1420	1410	1400	1380	1350	1330	1300
1600	1660	1640	1630	1610	1600	1570	1540	1510	1480
1800	1880	1860	1840	1820	1800	1760	1720	1670	1630
2000	2110	2080	2050	2030	2000	1950	1890	1840	1780
2200	2330	2300	2260	2230	2200	2130	2070	2000	1940
2400	2550	2510	2480	2440	2400	2320	2250	2170	2090
2600	2780	2730	2690	2640	2600	2510	2420	2330	2250
2800	3000	2950	2900	2850	2800	2700	2600	2500	2400
3000	3220	3170	3110	3060	3000	2880	2770	2650	2540
3200	3450	3390	3320	3260	3200	3070	2940	2810	2680
3400	3670	3600	3540	3470	3400	3250	3110	2960	2810
3600	3900	3820	3750	3670	3600	3440	3280	3110	2950
3800	4120	4040	3960	3880	3800	3620	3450	3270	3090
4000	4340	4260	4170	4090	4000	3810	3610	3420	3230

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH(M)					
	WIND COMPONENT (KTS)					
	-10	0	10	20	30	40
1200	970	1200	1280	1360	1450	1540
1400	1140	1400	1490	1580	1670	1760
1600	1320	1600	1690	1790	1890	1990
1800	1500	1800	1900	2000	2100	2210
2000	1680	2000	2100	2210	2320	2430
2200	1860	2200	2310	2420	2540	2660
2400	2040	2400	2520	2640	2760	2880
2600	2220	2600	2720	2850	2980	3110
2800	2400	2800	2930	3060	3200	3330
3000	2580	3000	3140	3270	3410	3560
3200	2760	3200	3340	3490	3630	3780
3400	2940	3400	3550	3700	3850	4000
3600	3110	3600	3750	3910	4070	4230
3800	3290	3800	3960	4120	4290	4450
4000	3470	4000	4170	4330	4510	4680

Takeoff Field & Climb Limit Weights - Dry Runway**Flaps 15****Sea Level Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	(OAT)											
	°C	-40	14	18	22	25	29	31	33	42	46	50
	°F	-40	57	64	72	77	84	88	91	108	115	122
1200	185.7	165.0	163.6	162.2	161.2	159.8	159.1	158.3	147.1	141.3	135.3	
1400	201.7	182.4	181.1	179.8	178.8	177.5	176.9	176.1	165.7	160.2	154.7	
1600	217.1	197.3	196.0	194.6	193.7	192.4	191.7	190.9	180.2	174.6	168.9	
1800	231.4	210.6	209.1	207.7	206.7	205.3	204.6	203.8	192.5	186.7	180.6	
2000	243.5	222.1	220.6	219.1	218.1	216.7	216.0	215.1	203.5	197.4	191.2	
2200	255.1	233.0	231.5	230.0	228.9	227.4	226.7	225.8	213.9	207.6	201.2	
2400	266.2	243.4	241.8	240.3	239.2	237.7	236.9	236.0	223.7	217.3	210.7	
2600	276.7	253.3	251.6	250.1	248.9	247.4	246.6	245.7	233.0	226.4	219.6	
2800	286.7	262.5	260.8	259.2	258.0	256.4	255.6	254.7	241.6	234.8	227.8	
3000	296.0	271.0	269.3	267.6	266.3	264.7	263.9	262.9	249.3	242.3	235.1	
3200	304.9	279.1	277.3	275.6	274.3	272.6	271.8	270.7	256.8	249.5	242.0	
3400	313.4	286.8	285.0	283.2	281.9	280.1	279.3	278.2	263.9	256.3	248.7	
3600	321.5	294.2	292.4	290.5	289.2	287.4	286.5	285.4	270.6	262.9	255.0	
3800	329.3	301.3	299.4	297.5	296.1	294.3	293.4	292.3	277.1	269.2	261.1	
4000	336.6	308.0	306.0	304.1	302.7	300.8	299.9	298.8	283.3	275.2	267.0	
CLIMB LIMIT WT (1000 KG)	262.0	250.7	250.4	250.1	250.0	249.8	249.7	249.5	226.5	215.5	204.5	

1000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	(OAT)											
	°C	-40	14	18	22	25	29	31	33	42	46	50
	°F	-40	57	64	72	77	84	88	91	108	115	122
1200	181.3	160.8	159.4	158.0	157.0	155.7	154.9	152.7	140.8	135.0	128.5	
1400	197.6	178.4	177.1	175.8	174.9	173.7	172.9	170.9	159.7	154.4	148.3	
1600	212.9	193.3	191.9	190.6	189.7	188.4	187.7	185.6	174.1	168.6	162.4	
1800	226.9	206.3	204.9	203.5	202.5	201.2	200.4	198.2	186.1	180.3	173.8	
2000	238.9	217.6	216.2	214.8	213.7	212.4	211.5	209.3	196.9	190.9	184.2	
2200	250.4	228.4	227.0	225.5	224.4	223.0	222.2	219.8	207.0	200.9	193.9	
2400	261.3	238.7	237.2	235.7	234.6	233.1	232.3	229.9	216.7	210.4	203.2	
2600	271.7	248.4	246.9	245.3	244.2	242.7	241.8	239.3	225.8	219.2	211.9	
2800	281.5	257.5	255.9	254.3	253.1	251.6	250.7	248.1	234.2	227.4	219.9	
3000	290.6	265.8	264.2	262.5	261.3	259.7	258.7	256.1	241.6	234.7	226.8	
3200	299.4	273.8	272.0	270.3	269.1	267.5	266.5	263.7	248.8	241.6	233.6	
3400	307.7	281.4	279.6	277.8	276.5	274.9	273.8	271.0	255.7	248.3	239.9	
3600	315.7	288.6	286.8	285.0	283.7	281.9	280.9	278.0	262.2	254.6	246.1	
3800	323.3	295.5	293.7	291.8	290.5	288.7	287.6	284.7	268.5	260.7	252.0	
4000	330.5	302.1	300.2	298.3	296.9	295.1	294.0	291.0	274.5	266.5	257.6	
CLIMB LIMIT WT (1000 KG)	249.7	248.4	248.2	247.8	247.3	246.9	246.7	241.2	218.8	208.0	196.0	

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1500 kg.

With engine and wing anti-ice on, decrease field limit weight by 600 kg and climb limit weight by 900 kg.

Takeoff Field & Climb Limit Weights - Dry Runway**Flaps 15****2000 FT Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	(OAT)											
	°C	-40	14	18	22	25	29	31	33	42	46	50
	°F	-40	57	64	72	77	84	88	91	108	115	122
1200	176.6	156.5	155.2	153.9	152.9	151.4	149.2	146.9	134.4	128.7	121.9	
1400	193.2	174.5	173.2	172.0	171.1	169.7	167.6	165.5	153.8	148.4	142.1	
1600	208.4	189.2	187.9	186.7	185.7	184.3	182.2	180.0	168.1	162.6	156.1	
1800	222.3	202.0	200.7	199.3	198.4	196.9	194.6	192.3	179.7	173.9	167.1	
2000	234.1	213.3	211.9	210.5	209.5	208.0	205.6	203.3	190.3	184.3	177.2	
2200	245.4	223.9	222.5	221.1	220.0	218.5	216.1	213.6	200.3	194.1	186.8	
2400	256.2	234.1	232.6	231.1	230.1	228.5	226.0	223.5	209.7	203.4	195.9	
2600	266.4	243.6	242.1	240.6	239.5	237.9	235.3	232.7	218.6	212.0	204.3	
2800	276.1	252.6	251.0	249.5	248.3	246.6	244.0	241.4	226.8	220.0	212.1	
3000	285.0	260.7	259.1	257.5	256.3	254.6	251.8	249.1	234.0	227.0	218.8	
3200	293.6	268.5	266.8	265.2	264.0	262.1	259.3	256.5	240.9	233.7	225.2	
3400	301.8	275.9	274.2	272.5	271.3	269.4	266.5	263.6	247.5	240.1	231.4	
3600	309.6	283.0	281.3	279.5	278.2	276.3	273.3	270.4	253.9	246.2	237.3	
3800	317.0	289.8	288.0	286.2	284.9	282.9	279.9	276.8	259.9	252.1	243.0	
4000	324.1	296.3	294.4	292.6	291.2	289.2	286.1	283.0	265.7	257.7	248.4	
CLIMB LIMIT WT (1000 KG)	246.8	245.0	244.5	244.0	243.7	243.1	238.2	234.5	210.8	200.2	188.0	

3000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	(OAT)											
	°C	-40	14	18	22	25	29	31	33	42	46	50
	°F	-40	57	64	72	77	84	88	91	108	115	122
1200	171.7	152.0	150.7	149.4	148.4	144.4	142.2	139.7	127.4	121.3	114.7	
1400	188.6	170.3	169.0	167.8	166.9	163.2	161.1	158.7	147.3	141.6	135.5	
1600	203.7	184.9	183.6	182.4	181.5	177.7	175.5	173.1	161.4	155.5	149.3	
1800	217.3	197.5	196.1	194.8	193.9	189.8	187.6	185.1	172.7	166.5	159.9	
2000	229.0	208.6	207.2	205.8	204.8	200.7	198.3	195.8	183.0	176.7	169.8	
2200	240.1	219.1	217.7	216.3	215.3	211.0	208.6	205.9	192.8	186.2	179.2	
2400	250.7	229.1	227.6	226.2	225.2	220.8	218.3	215.5	202.0	195.3	188.0	
2600	260.8	238.5	237.0	235.6	234.5	229.9	227.4	224.6	210.7	203.7	196.3	
2800	270.3	247.3	245.8	244.3	243.1	238.5	235.8	232.9	218.6	211.4	203.8	
3000	279.0	255.3	253.7	252.1	250.9	246.1	243.4	240.4	225.5	218.1	210.2	
3200	287.4	262.9	261.2	259.6	258.4	253.4	250.6	247.5	232.2	224.5	216.4	
3400	295.4	270.1	268.4	266.8	265.5	260.4	257.5	254.3	238.6	230.7	222.2	
3600	303.0	277.1	275.3	273.6	272.4	267.1	264.1	260.8	244.6	236.6	227.9	
3800	310.3	283.7	281.9	280.2	278.9	273.5	270.4	267.1	250.5	242.2	233.3	
4000	317.2	290.0	288.2	286.4	285.1	279.6	276.4	273.0	256.1	247.6	238.5	
CLIMB LIMIT WT (1000 KG)	242.4	241.1	241.0	240.8	240.2	232.5	229.0	224.5	201.5	190.8	180.2	

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1500 kg.

With engine and wing anti-ice on, decrease field limit weight by 600 kg and climb limit weight by 900 kg.

Takeoff Field Corrections - Wet Runway
Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH(M)								
	RUNWAY SLOPE (%)								
	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
1200	1210	1210	1210	1200	1200	1180	1150	1130	1100
1400	1430	1430	1420	1410	1400	1370	1340	1310	1280
1600	1660	1640	1630	1610	1600	1560	1530	1490	1450
1800	1880	1860	1840	1820	1800	1760	1710	1670	1630
2000	2110	2080	2050	2030	2000	1950	1900	1850	1800
2200	2330	2300	2260	2230	2200	2140	2090	2030	1980
2400	2550	2510	2480	2440	2400	2340	2280	2210	2150
2600	2780	2730	2690	2640	2600	2530	2460	2390	2330
2800	3000	2950	2900	2850	2800	2730	2650	2580	2500
3000	3220	3170	3110	3060	3000	2920	2840	2760	2680
3200	3450	3390	3320	3260	3200	3110	3030	2940	2850
3400	3670	3600	3540	3470	3400	3310	3210	3120	3030
3600	3900	3820	3750	3670	3600	3500	3400	3300	3200
3800	4120	4040	3960	3880	3800	3690	3590	3480	3380
4000	4340	4260	4170	4090	4000	3890	3780	3660	3550

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M)					
	WIND COMPONENT (KTS)					
	-10	0	10	20	30	40
1200	930	1200	1290	1380	1480	1580
1400	1100	1400	1490	1590	1700	1810
1600	1280	1600	1700	1810	1920	2040
1800	1460	1800	1910	2030	2150	2270
2000	1640	2000	2120	2240	2370	2500
2200	1820	2200	2330	2460	2590	2730
2400	1990	2400	2530	2670	2820	2960
2600	2170	2600	2740	2890	3040	3200
2800	2350	2800	2950	3100	3260	3430
3000	2530	3000	3160	3320	3490	3660
3200	2710	3200	3360	3530	3710	3890
3400	2880	3400	3570	3750	3930	4120
3600	3060	3600	3780	3960	4160	4350
3800	3240	3800	3990	4180	4380	4580
4000	3420	4000	4190	4400	4600	4820

Takeoff Field & Climb Limit Weights - Wet Runway**Flaps 15****Sea Level Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	(OAT)											
	°C	-40	14	18	22	25	29	31	33	42	46	50
	°F	-40	57	64	72	77	84	88	91	108	115	122
1200	185.7	165.0	163.6	162.2	161.2	159.8	159.1	158.3	147.1	141.3	135.3	
1400	201.4	181.9	180.6	179.3	178.3	177.1	176.4	175.7	165.5	160.2	154.7	
1600	215.9	195.8	194.4	193.0	192.0	190.7	190.0	189.3	178.8	173.3	167.8	
1800	229.6	208.2	206.7	205.3	204.2	202.8	202.1	201.3	190.2	184.4	178.5	
2000	242.3	219.7	218.1	216.6	215.5	214.0	213.3	212.4	200.7	194.6	188.4	
2200	254.3	230.6	229.0	227.4	226.2	224.7	223.9	223.0	210.7	204.3	197.8	
2400	265.6	240.9	239.2	237.5	236.3	234.7	233.9	232.9	220.1	213.4	206.6	
2600	276.3	250.6	248.8	247.1	245.8	244.1	243.3	242.3	228.9	222.0	215.0	
2800	286.4	259.8	258.0	256.2	254.9	253.1	252.2	251.2	237.4	230.2	222.9	
3000	296.0	268.4	266.5	264.7	263.3	261.5	260.6	259.5	245.2	237.8	230.3	
3200	304.9	276.7	274.8	272.9	271.4	269.6	268.7	267.5	252.8	245.1	237.3	
3400	313.4	284.7	282.7	280.7	279.3	277.3	276.4	275.2	260.0	252.1	244.1	
3600	321.5	292.4	290.3	288.3	286.8	284.8	283.8	282.6	267.0	258.9	250.6	
3800	329.3	299.7	297.6	295.5	294.0	292.0	291.0	289.7	273.7	265.3	256.9	
4000	336.6	306.7	304.5	302.4	300.8	298.8	297.7	296.5	280.0	271.5	262.8	
CLIMB LIMIT WT (1000 KG)	252.0	250.7	250.4	250.1	250.0	249.8	249.7	249.5	226.5	215.5	204.5	

1000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	(OAT)											
	°C	-40	14	18	22	25	29	31	33	42	46	50
	°F	-40	57	64	72	77	84	88	91	108	115	122
1200	181.3	160.8	159.4	158.0	157.0	155.7	154.9	152.7	140.8	135.0	128.5	
1400	197.2	177.9	176.6	175.3	174.4	173.2	172.4	170.5	159.7	154.4	148.3	
1600	211.6	191.6	190.2	188.9	187.9	186.7	185.9	183.9	172.7	167.4	161.5	
1800	225.0	203.8	202.4	201.0	199.9	198.6	197.7	195.6	183.7	178.1	171.8	
2000	237.4	215.0	213.5	212.0	211.0	209.5	208.6	206.4	193.9	187.9	181.3	
2200	249.2	225.7	224.1	222.6	221.4	219.9	219.0	216.6	203.5	197.3	190.3	
2400	260.2	235.8	234.1	232.5	231.3	229.7	228.8	226.3	212.6	206.1	198.8	
2600	270.7	245.3	243.5	241.9	240.6	239.0	238.0	235.4	221.2	214.4	206.9	
2800	280.7	254.3	252.5	250.8	249.5	247.8	246.8	244.1	229.4	222.3	214.5	
3000	290.0	262.7	260.9	259.1	257.7	256.0	254.9	252.2	236.9	229.7	221.6	
3200	299.0	270.8	268.9	267.1	265.7	263.9	262.8	259.9	244.2	236.7	228.4	
3400	307.7	278.6	276.7	274.8	273.3	271.5	270.4	267.4	251.2	243.5	234.9	
3600	315.7	286.1	284.1	282.2	280.7	278.8	277.6	274.6	257.9	250.0	241.1	
3800	323.3	293.3	291.3	289.2	287.7	285.8	284.6	281.5	264.4	256.2	247.1	
4000	330.5	300.2	298.1	296.0	294.4	292.4	291.2	288.0	270.5	262.1	252.8	
CLIMB LIMIT WT (1000 KG)	249.7	248.4	248.2	247.8	247.3	246.9	246.7	241.2	218.8	208.0	196.0	

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1500 kg.

With engine and wing anti-ice on, decrease field limit weight by 600 kg and climb limit weight by 900 kg.

Takeoff Field & Climb Limit Weights - Wet Runway**Flaps 15****2000 FT Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	(OAT)										
	°C -40	14	18	22	25	29	31	33	42	46	50
	°F -40	57	64	72	77	84	88	91	108	115	122
1200	176.6	156.5	155.2	153.9	152.9	151.4	149.2	146.9	134.4	128.7	121.9
1400	192.8	173.9	172.7	171.4	170.5	169.2	167.1	165.1	153.8	148.4	142.1
1600	207.0	187.5	186.2	184.9	183.9	182.5	180.4	178.3	166.7	161.4	155.3
1800	220.2	199.4	198.0	196.6	195.6	194.2	191.9	189.7	177.4	171.7	165.2
2000	232.3	210.4	209.0	207.5	206.4	204.9	202.5	200.1	187.2	181.2	174.4
2200	243.9	220.9	219.3	217.8	216.7	215.0	212.6	210.1	196.5	190.2	183.1
2400	254.7	230.7	229.1	227.5	226.3	224.6	222.1	219.5	205.3	198.8	191.3
2600	264.9	240.0	238.3	236.7	235.5	233.7	231.0	228.3	213.6	206.8	199.0
2800	274.7	248.9	247.1	245.4	244.2	242.3	239.5	236.7	221.4	214.4	206.4
3000	283.8	257.1	255.3	253.5	252.2	250.3	247.4	244.6	228.7	221.5	213.2
3200	292.6	265.0	263.2	261.4	260.0	258.0	255.1	252.1	235.8	228.3	219.7
3400	301.1	272.7	270.8	268.9	267.5	265.5	262.4	259.3	242.5	234.8	225.9
3600	309.2	280.0	278.0	276.1	274.7	272.6	269.4	266.3	249.0	241.0	231.9
3800	317.0	287.0	285.0	283.0	281.5	279.4	276.2	272.9	255.2	247.0	237.7
4000	324.1	293.7	291.6	289.6	288.1	285.9	282.6	279.3	261.1	252.7	243.2
CLIMB LIMIT WT (1000 KG)	246.8	245.0	244.5	244.0	243.7	243.1	238.2	234.5	210.8	200.2	188.0

3000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	(OAT)										
	°C -40	14	18	22	25	29	31	33	42	46	50
	°F -40	57	64	72	77	84	88	91	108	115	122
1200	171.7	152.0	150.7	149.4	148.4	144.4	142.2	139.7	127.4	121.3	114.7
1400	188.2	169.7	168.4	167.2	166.3	162.7	160.7	158.5	147.3	141.6	135.5
1600	202.2	183.1	181.8	180.5	179.6	175.9	173.8	171.5	160.1	154.6	149.2
1800	215.1	194.7	193.4	192.0	191.1	187.1	184.8	182.4	170.4	164.5	158.7
2000	226.9	205.5	204.1	202.6	201.6	197.4	195.1	192.5	179.8	173.6	167.5
2200	238.2	215.7	214.2	212.7	211.6	207.2	204.7	202.1	188.8	182.3	175.9
2400	248.7	225.3	223.7	222.2	221.1	216.5	213.9	211.1	197.2	190.5	183.8
2600	258.8	234.4	232.8	231.2	230.0	225.2	222.5	219.6	205.2	198.2	191.2
2800	268.3	243.0	241.3	239.7	238.5	233.5	230.7	227.7	212.8	205.5	198.3
3000	277.2	251.1	249.3	247.6	246.4	241.2	238.4	235.2	219.8	212.2	204.8
3200	285.8	258.8	257.0	255.3	253.9	248.7	245.7	242.5	226.5	218.7	211.0
3400	294.0	266.3	264.4	262.6	261.2	255.8	252.7	249.4	232.9	224.9	217.0
3600	302.0	273.4	271.5	269.6	268.2	262.6	259.5	256.0	239.1	230.9	222.7
3800	309.6	280.2	278.3	276.4	274.9	269.2	266.0	262.4	245.1	236.6	228.2
4000	316.8	286.8	284.8	282.8	281.3	275.4	272.1	268.5	250.8	242.1	233.5
CLIMB LIMIT WT (1000 KG)	242.4	241.1	241.0	240.8	240.2	232.5	229.0	224.5	201.5	190.8	180.2

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1500 kg.

With engine and wing anti-ice on, decrease field limit weight by 600 kg and climb limit weight by 900 kg.

Takeoff Obstacle Limit Weight**Flaps 15**

Sea Level, 33°C & Below, Zero Wind

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	227.9	246.2	257.8								
20	208.0	224.1	236.9	247.1	254.8	259.7					
40	190.8	205.7	218.7	229.2	237.7	245.0	250.8	254.7	257.9	260.6	262.9
60	177.9	193.0	205.7	216.3	225.0	232.2	238.1	243.2	248.7	251.9	254.6
80	168.0	183.0	195.4	205.8	214.7	222.1	228.4	233.8	238.4	242.5	246.7
100	159.3	174.4	186.8	197.1	205.9	213.5	220.1	225.7	230.6	234.8	238.6
120	151.2	167.0	179.2	189.5	198.3	205.9	212.6	218.5	223.5	228.0	232.0
140		160.3	172.5	182.8	191.6	199.2	205.9	211.9	217.2	221.8	226.0
160		154.0	166.4	176.7	185.5	193.2	199.9	206.0	211.3	216.1	220.4
180		148.1	160.9	171.1	179.9	187.7	194.5	200.5	206.0	210.9	215.3
200			155.7	166.0	174.8	182.6	189.5	195.6	201.0	205.9	210.5
220			150.8	161.3	170.1	177.8	184.8	190.9	196.4	201.4	205.9
240			146.2	156.9	165.7	173.4	180.3	186.6	192.1	197.1	201.7
260				152.7	161.6	169.3	176.2	182.4	188.1	193.1	197.7

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustment

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)							
	140	160	180	200	220	240	260	280
33 & BELOW	0	0	0	0	0	0	0	0
34	-1.2	-1.5	-1.7	-2.0	-2.3	-2.6	-2.9	-3.1
36	-3.1	-3.9	-4.6	-5.4	-6.1	-6.9	-7.6	-8.4
38	-5.1	-6.3	-7.5	-8.7	-10.0	-11.2	-12.4	-13.6
40	-7.1	-8.7	-10.4	-12.1	-13.8	-15.5	-17.1	-18.8
42	-9.4	-11.7	-13.9	-16.1	-18.4	-20.6	-22.8	-25.1
44	-11.8	-14.6	-17.4	-20.2	-23.0	-25.8	-28.6	-31.4
46	-14.1	-17.5	-20.8	-24.2	-27.5	-30.9	-34.3	-37.6
48	-16.4	-20.4	-24.3	-28.2	-32.1	-36.0	-40.0	-43.9
50	-18.8	-23.3	-27.7	-32.2	-36.7	-41.2	-45.7	-50.2

Pressure Altitude Adjustment

ALT (FT)	TEMP CORR'D OBSTACLE LIMIT WEIGHT (1000 KG)							
	140	160	180	200	220	240	260	280
S.L. & BELOW	0	0	0	0	0	0	0	0
1000	-3.3	-4.1	-4.8	-5.6	-6.3	-7.0	-7.8	-8.5
2000	-7.3	-8.6	-9.9	-11.2	-12.5	-13.8	-15.1	-16.4
3000	-12.0	-14.3	-16.7	-19.0	-21.3	-23.6	-25.9	-28.3

Wind Adjustment

WIND (KTS)	TEMP & ALT CORR'D OBSTACLE LIMIT WEIGHT (1000 KG)							
	140	160	180	200	220	240	260	280
0	0	0	0	0	0	0	0	0
10 HW	4.0	3.6	3.2	2.9	2.5	2.1	1.8	1.4
20 HW	8.0	7.2	6.5	5.7	5.0	4.3	3.5	2.8
30 HW	12.0	10.9	9.8	8.7	7.6	6.4	5.3	4.2
40 HW	16.1	14.6	13.1	11.6	10.1	8.6	7.1	5.6

Takeoff Speeds - Dry Runway

Flaps 15

V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	KIAS		
	V1	VR	V2
250	144	148	153
240	139	145	151
230	137	141	148
220	133	138	145
210	129	134	142
200	124	131	138
190	119	127	135
180	114	123	132
170	109	119	129
160	103	114	125
150	98	110	122
140	91	106	118

Check V1(MCG).

V1, VR, V2 Adjustments*

TEMP		V1					VR					V2				
		PRESS ALT (1000 FT)					PRESS ALT (1000 FT)					PRESS ALT (1000 FT)				
°C	°F	-2	0	1	2	3	-2	0	1	2	3	-2	0	1	2	3
50	122	5	7	8	9	11	2	3	3	3	4	-1	-1	-2	-2	-2
40	104	1	2	4	5	6	0	1	1	2	2	0	-1	-1	-1	-1
30	86	0	0	0	1	2	0	0	0	0	1	0	0	0	0	0
20	68	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
-40	-40	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Slope and Wind V1 Adjustments*

WEIGHT (1000 KG)	SLOPE (%)					WIND (KTS)							
	-2	-1	0	1	2	-10	-5	0	10	20	30	40	
280	-5	-2	0	2	4	-1	-1	0	0	1	1	1	
260	-4	-2	0	2	3	-1	0	0	0	1	1	1	
240	-4	-2	0	2	3	-1	0	0	0	1	1	1	
220	-3	-1	0	2	3	-1	0	0	0	1	1	2	
200	-3	-1	0	2	3	-1	0	0	0	1	1	2	
180	-3	-1	0	2	3	-1	0	0	0	1	1	2	
160	-3	-1	0	2	3	-1	0	0	0	1	1	2	

*V1 not to exceed VR

V1(MCG)

Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)				
		-2000	0	1000	2000	3000
50	122	110	107	105	103	102
40	104	115	113	112	110	108
30	86	117	117	117	116	113
20	68	117	117	117	116	116
-40	-40	118	118	118	117	116

Takeoff Speeds - Wet Runway**Flaps 15****V1, VR, V2 for Max Takeoff Thrust**

WEIGHT (1000 KG)	KIAS		
	V1	VR	V2
250	137	148	153
240	133	145	151
230	129	141	148
220	125	138	145
210	120	134	142
200	116	131	138
190	111	127	135
180	106	123	132
170	101	119	129
160	96	114	125
150	91	110	122
140	85	106	118

Check V1(MCG).

V1, VR, V2 Adjustment*

TEMP		V1					VR					V2				
		PRESS ALT (1000 FT)					PRESS ALT (1000 FT)					PRESS ALT (1000 FT)				
°C	°F	-2	0	1	2	3	-2	0	1	2	3	-2	0	1	2	3
50	122	5	7	8	9	11	2	3	3	3	4	-1	-1	-2	-2	-2
40	104	1	2	4	5	6	0	1	1	2	2	0	-1	-1	-1	-1
30	86	0	0	0	1	2	0	0	0	0	1	0	0	0	0	0
20	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-40	-40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Slope and Wind V1 Adjustment*

WEIGHT (1000 KG)	SLOPE (%)					WIND (KTS)						
	-2	-1	0	1	2	-10	-5	0	10	20	30	40
260	-5	-3	0	3	5	-2	-1	0	1	2	2	3
240	-5	-3	0	3	5	-3	-1	0	1	2	2	3
220	-5	-3	0	2	5	-3	-1	0	1	2	2	3
200	-5	-3	0	2	4	-3	-2	0	1	2	2	4
180	-5	-2	0	2	4	-3	-1	0	1	2	3	4
160	-4	-2	0	2	4	-3	-1	0	1	2	3	4

*V1 not to exceed VR

V1(MCG)**Max Takeoff Thrust**

TEMP		PRESSURE ALTITUDE (FT)				
°C	°F	-2000	0	1000	2000	3000
50	122	110	107	105	103	102
40	104	115	113	112	110	108
30	86	117	117	117	116	113
20	68	117	117	117	116	116
-40	-40	118	118	118	117	116

Minimum V2**Max Takeoff Thrust**

Intentionally
Blank

Performance Dispatch**Chapter PD****Enroute****Section 11****Long Range Cruise Maximum Operating Altitude****Max Climb Thrust****ISA + 10°C and Below**

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30500	-2	33000*	32600	31100
290	31200	-3	34100*	33300	31800
280	32000	-5	35100*	34000	32600
270	32800	-7	35900*	34800	33300
260	33600	-9	36500*	35600	34200
250	34400	-11	37300*	36400	35000
240	35300	-12	38200*	37300	35800
230	36200	-14	39000*	38100	36700
220	37100	-14	39900*	39100	37600
210	38100	-14	40800*	40000	38600
200	39100	-14	41800*	41100	39600
190	40100	-14	42800*	42100	40700
180	41300	-14	43000	43000	41800
170	42500	-14	43000	43000	43000
160	43000	-14	43000	43000	43000
150	43000	-14	43000	43000	43000
140	43000	-14	43000	43000	43000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30500	4	31400*	31400*	31100
290	31200	2	32700*	32700*	31800
280	32000	1	33900*	33900*	32600
270	32800	-1	35100*	34800	33300
260	33600	-3	35900*	35600	34200
250	34400	-5	36500*	36400	35000
240	35300	-7	37400*	37300	35800
230	36200	-9	38300*	38100	36700
220	37100	-9	39200*	39100	37600
210	38100	-9	40000*	40000	38600
200	39100	-9	40900*	40900*	39600
190	40100	-9	41900*	41900*	40700
180	41300	-9	42900*	42900*	41800
170	42500	-9	43000	43000	43000
160	43000	-9	43000	43000	43000
150	43000	-9	43000	43000	43000
140	43000	-9	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30500	10	26100*	26100*	26100*
290	31200	8	27600*	27600*	27600*
280	32000	6	31700*	31700*	31700*
270	32800	5	33400*	33400*	33300
260	33600	3	34900*	34900*	34200
250	34400	1	35800*	35800*	35000
240	35300	-1	36400*	36400*	35800
230	36200	-3	37300*	37300*	36700
220	37100	-3	38200*	38200*	37600
210	38100	-3	39200*	39200*	38600
200	39100	-3	40000*	40000*	39600
190	40100	-3	41000*	41000*	40700
180	41300	-3	42000*	42000*	41800
170	42500	-3	43000	43000	43000
160	43000	-3	43000	43000	43000
150	43000	-3	43000	43000	43000
140	43000	-3	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCED (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
531	499	469	444	421	400	382	366	351	337	325
1056	993	936	886	841	800	766	735	706	679	656
1578	1485	1401	1327	1261	1200	1150	1104	1061	1022	986
2097	1977	1866	1768	1681	1600	1535	1473	1417	1365	1317
2616	2467	2330	2209	2100	2000	1919	1843	1772	1708	1648
3133	2955	2793	2649	2519	2400	2303	2212	2128	2051	1980
3649	3443	3255	3088	2938	2800	2687	2582	2484	2394	2311
4163	3930	3717	3527	3357	3200	3071	2951	2840	2737	2643
4676	4415	4178	3966	3775	3600	3455	3320	3195	3080	2974
5187	4900	4638	4404	4194	4000	3840	3690	3551	3423	3305
5697	5384	5097	4842	4612	4400	4224	4059	3906	3765	3636
6205	5866	5556	5280	5030	4800	4608	4429	4262	4108	3967
6712	6348	6015	5717	5448	5200	4992	4798	4618	4451	4299
7218	6829	6472	6154	5865	5600	5376	5167	4973	4794	4630
7723	7309	6930	6590	6283	6000	5761	5537	5329	5137	4961
8226	7788	7386	7026	6700	6400	6145	5906	5685	5480	5292
8729	8266	7842	7462	7117	6800	6529	6276	6040	5823	5623
9231	8744	8298	7898	7535	7200	6913	6645	6396	6166	5954
9733	9222	8754	8333	7952	7600	7297	7014	6751	6508	6285
10235	9700	9209	8769	8369	8000	7681	7383	7106	6851	6616

Reference Fuel and Time Required

AIR DIST(NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37 & ABOVE	
	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)
400	6.7	1:04	6.5	1:04	3.5	0:36	3.4	0:35	3.4	0:34
800	12.1	2:01	11.6	1:59	10.4	1:48	10.3	1:45	10.2	1:43
1200	17.5	2:57	16.8	2:54	16.5	2:50	16.3	2:46	16.0	2:42
1600	23.0	3:53	22.1	3:48	21.7	3:42	21.3	3:37	21.0	3:33
2000	28.5	4:48	27.4	4:42	26.8	4:35	26.4	4:29	25.9	4:23
2400	34.2	5:42	33.0	5:34	32.2	5:26	31.6	5:19	31.1	5:13
2800	39.9	6:36	38.5	6:27	37.6	6:18	36.9	6:09	36.3	6:02
3200	45.7	7:30	44.1	7:19	43.2	7:09	42.3	6:59	41.6	6:52
3600	51.7	8:22	49.9	8:11	48.8	7:59	47.9	7:49	47.0	7:42
4000	57.6	9:15	55.7	9:02	54.5	8:49	53.4	8:39	52.5	8:32
4400	63.9	10:06	61.7	9:53	60.4	9:39	59.2	9:28	58.3	9:21
4800	70.1	10:58	67.8	10:43	66.3	10:28	65.0	10:18	64.1	10:11
5200	76.5	11:49	74.0	11:33	72.4	11:18	71.0	11:07	70.2	11:01
5600	83.0	12:39	80.3	12:22	78.6	12:07	77.2	11:57	76.6	11:51
6000	89.5	13:29	86.7	13:11	84.8	12:56	83.4	12:46	82.9	12:41
6400	96.3	14:18	93.4	14:00	91.4	13:45	90.0	13:36		
6800	103.2	15:08	100.0	14:49	98.0	14:34	96.7	14:26		
7200	110.2	15:57	106.9	15:38	104.7	15:23				
7600	117.3	16:46	113.9	16:27	111.8	16:13				
8000	124.5	17:34	120.9	17:15	118.8	17:02				

Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	FUEL REQUIRED ADJUSTMENTS (1000 KG)				
	LANDING WEIGHT (1000 KG)				
	140	160	180	200	220
10	-1.3	-0.6	0.0	0.8	1.6
20	-2.4	-1.1	0.0	1.6	3.5
30	-3.5	-1.7	0.0	2.5	5.7
40	-4.7	-2.2	0.0	3.6	8.4
50	-5.8	-2.8	0.0	4.8	11.4
60	-7.0	-3.4	0.0	6.2	14.9
70	-8.3	-4.1	0.0	7.8	18.8
80	-9.6	-4.7	0.0	9.5	23.1
90	-10.9	-5.4	0.0	11.4	27.8
100	-12.2	-6.1	0.0	13.4	33.0
110	-13.6	-6.9	0.0	15.6	38.5
120	-15.0	-7.7	0.0	18.0	44.5
130	-16.5	-8.4	0.0	20.5	50.8

Based on 310/.84 climb, LRC cruise and .84/310/250 descent.

**Long Range Cruise Step Climb Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1038	980	928	881	839	800	765	733	703	676	651
1543	1459	1385	1317	1256	1200	1149	1102	1059	1019	982
2047	1939	1841	1753	1673	1600	1533	1471	1415	1362	1313
2552	2418	2298	2189	2090	2000	1917	1841	1770	1705	1644
3056	2898	2755	2626	2508	2400	2301	2210	2126	2048	1976
3561	3377	3212	3062	2925	2800	2685	2580	2482	2391	2307
4065	3857	3668	3498	3342	3200	3069	2949	2838	2734	2638
4570	4336	4125	3934	3760	3600	3453	3318	3193	3078	2970
5074	4815	4582	4370	4177	4000	3838	3688	3549	3421	3301
5578	5295	5038	4806	4594	4400	4222	4057	3905	3764	3633
6082	5774	5495	5242	5011	4800	4606	4427	4261	4107	3964
6586	6253	5951	5678	5428	5200	4990	4796	4617	4451	4296
7090	6732	6408	6114	5846	5600	5374	5166	4973	4794	4628
7594	7211	6864	6550	6263	6000	5758	5535	5329	5138	4959
8097	7689	7321	6986	6680	6400	6143	5905	5685	5481	5291
8600	8168	7777	7421	7097	6800	6527	6275	6041	5825	5623
9104	8646	8233	7857	7514	7200	6911	6644	6397	6168	5955
9607	9125	8689	8293	7931	7600	7295	7014	6754	6512	6287
10110	9603	9145	8729	8348	8000	7680	7384	7110	6856	6619

Trip Fuel and Time Required

AIR DIST (NM)	TRIP FUEL (1000 KG)								TIME (HRS:MIN)
	LANDING WEIGHT (1000 KG)								
	140	150	160	170	180	190	200	210	
800	9.3	9.8	10.1	10.6	11.2	11.5	12.0	12.6	1:50
1200	13.3	13.8	14.4	15.2	15.9	16.5	17.3	18.1	2:40
1600	17.3	17.9	18.8	19.9	20.8	21.6	22.7	23.7	3:30
2000	21.3	22.2	23.3	24.6	25.7	26.8	28.2	29.5	4:20
2400	25.4	26.5	27.9	29.4	30.8	32.2	33.8	35.3	5:09
2800	29.6	31.0	32.6	34.4	36.0	37.7	39.5	41.3	5:59
3200	33.8	35.5	37.4	39.4	41.4	43.3	45.4	47.5	6:49
3600	38.2	40.2	42.3	44.6	46.9	49.1	51.4	53.8	7:38
4000	42.7	45.0	47.3	49.9	52.5	54.9	57.5	60.3	8:28
4400	47.3	49.8	52.4	55.4	58.2	60.9	63.9	66.9	9:18
4800	52.0	54.7	57.7	60.9	64.0	67.0	70.4	73.7	10:07
5200	56.8	59.8	63.1	66.6	70.0	73.3	77.0	80.6	10:57
5600	61.7	64.9	68.6	72.4	76.1	79.8	83.8	87.7	11:46
6000	66.6	70.3	74.2	78.3	82.3	86.4	90.7	94.9	12:35
6400	71.7	75.7	80.0	84.4	88.8	93.2	97.8	102.3	13:25
6800	77.0	81.3	85.8	90.6	95.4	100.1	105.0	109.9	14:14
7200	82.3	87.0	91.9	97.0	102.2	107.2	112.5	117.7	15:03
7600	87.9	92.8	98.0	103.6	109.0	114.4	120.0	125.6	15:53
8000	93.5	98.8	104.3	110.3	116.1	121.9	127.8	133.7	16:42

Based on 310/.84 climb, LRC and .84/310/250 descent.

Valid for all pressure altitudes with 4000 ft step climb to 2000 ft above optimum altitude.

Short Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
91	78	69	61	55	50	46	42	39	37	34
158	142	128	117	108	100	93	87	82	77	73
224	204	187	173	161	150	141	132	125	119	113
288	265	245	228	213	200	188	178	169	161	153
351	325	302	282	265	250	236	224	213	203	194
412	384	359	337	317	300	284	271	258	246	236
474	443	415	391	369	350	333	317	303	289	277
536	502	472	445	421	400	381	363	347	333	319
598	561	528	499	473	450	429	409	392	376	361
661	621	586	554	526	500	477	456	436	418	402

Trip Fuel and Time

AIR DIST (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		140	160	180	200	220	
50	FUEL (1000 KG)	1.4	1.5	1.6	1.7	1.8	0:14
	ALT (FT)	8000	8000	9000	6000	6000	
100	FUEL (1000 KG)	2.2	2.3	2.5	2.6	2.8	0:22
	ALT (FT)	14000	14000	14000	13000	12000	
150	FUEL (1000 KG)	2.9	3.1	3.3	3.5	3.7	0:30
	ALT (FT)	22000	21000	20000	19000	18000	
200	FUEL (1000 KG)	3.5	3.8	4.0	4.3	4.5	0:37
	ALT (FT)	27000	27000	26000	25p000	24000	
250	FUEL (1000 KG)	4.0	4.4	4.7	5.0	5.3	0:43
	ALT (FT)	33000	33000	32000	28000	28000	
300	FUEL (1000 KG)	4.6	4.9	5.3	5.7	6.0	0:49
	ALT (FT)	35000	35000	33000	30000	30000	
350	FUEL (1000 KG)	5.0	5.6	5.9	6.3	6.7	0:55
	ALT (FT)	40000	39000	37000	35000	31000	
400	FUEL (1000 KG)	5.5	6.0	6.5	7.0	7.4	1:01
	ALT (FT)	41000	41000	39000	36000	34000	
450	FUEL (1000 KG)	6.0	6.5	7.0	7.6	8.1	1:07
	ALT (FT)	41000	41000	39000	37000	36000	
500	FUEL (1000 KG)	6.5	7.1	7.6	8.2	8.8	1:13
	ALT (FT)	41000	41000	40000	37000	36000	

Holding Planning
Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)									
	PRESSURE ALTITUDE (FT)									
	1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
260	7210	7170	6960	6840	7040	7240	7440	7880		
240	6680	6610	6430	6300	6370	6740	6720	7070		
220	6160	6060	5910	5760	5760	5980	6070	6310	7020	
200	5670	5550	5410	5250	5220	5290	5430	5610	6080	
180	5190	5060	4930	4760	4720	4700	4860	4930	5290	5610
160	4720	4590	4470	4290	4240	4180	4170	4410	4690	4900
140	4260	4130	4010	3840	3780	3680	3700	3730	4000	4180

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
260	7560	7530	7370	7260	7320
240	6970	6930	6800	6660	6690
220	6390	6320	6230	6090	6080
200	5830	5740	5670	5520	5490
180	5280	5180	5110	4970	4940
160	4740	4640	4560	4430	4400
140	4230	4130	4020	3920	3890

These tables include 5% additional fuel for holding in a racetrack pattern.

Crew Oxygen Requirements

Table 1

NUMBER OF CREW	OXYGEN REQUIRED (LITERS)
2	660
3	990
4	1320

Table 2

NUMBER OF CREW	OXYGEN REQUIRED FOR LEVEL OFF AT 14000 FT (LITERS)			
	TOTAL POST DECOMPRESSION TIME (HR)			
	2	3	4	5
2	660	960	1270	1570
3	980	1440	1900	2360
4	1310	1920	2530	3140

Table 3

NUMBER OF CREW	ADDITIONAL LITERS REQUIRED FOR EACH MINUTE HELD AT INTERMEDIATE ALTITUDE OTHER THAN 14000 FT				
	INTERMEDIATE PRESSURE ALTITUDE (FT)				
	UP TO 13999	14000	14001 TO 17999	18000 TO 21999	22000 TO 25000
	REGULATOR ON "NORMAL" OR (100%)				
2	0 (22)	0 (17)	1 (16)	3 (12)	6 (10)
3	0 (33)	0 (25)	2 (24)	5 (18)	8 (15)
4	0 (44)	0 (34)	2 (32)	6 (24)	11 (20)

For more extensive than normal crew usage, add 2.05 liters/person/minute for each crew member at 8000 ft cabin altitude when regulator setting is NORMAL; or 13 liters/person/minute when regulator setting is 100%.

Instructions:

1. Determine protective breathing requirements from Table 1.
2. Determine supplemental requirements for level off at 14000 ft from Table 2 and correct for level off altitudes other than 14000 ft using Table 3.
3. Flight crew system oxygen requirements are the larger of protective breathing (Table 1) or supplemental requirements (Table 2).

Crew Oxygen Requirements**Table 4 - Cylinder Volume to Pressure Conversion**

OXYGEN VOLUME (1000 LITERS)	CYLINDER PRESSURE AT 21°C (PSI)
.1	200
.3	300
.5	400
.7	500
.8	600
1.0	700
1.2	800
1.4	900
1.5	1000
1.7	1100
1.9	1200
2.1	1300
2.2	1400
2.4	1500
2.6	1600
2.7	1700
2.9	1800
3.1	1900
3.3	2000

Check maximum pressure in shaded area. Maximum cylinder pressure = 1850 PSI at 21°C. For maximum cylinder pressure at hotter or colder temperatures, add or subtract 32 PSI per 5°C, respectively.

Table 5 - Temperature Corrections

CYLINDER PRESSURE AT 21°C (PSI)	PRESSURE CORRECTION FOR EACH 5°C ABOVE/BELOW 21°C (PSI)
400	+7/-7
600	+11/-11
800	+14/-14
1000	+17/-17
1200	+21/-21
1400	+24/-24
1600	+28/-28
1800	+31/-31
2000	+34/-34

ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
28	153.7	152.7	149.7
26	167.6	165.9	161.1
24	182.2	179.2	173.4
22	197.2	192.5	185.8
20	212.9	207.0	199.3
18	227.6	219.8	210.5
16	241.7	231.8	220.6
14	253.9	243.4	231.8
12	268.6	255.2	242.7
10	281.1	267.2	254.5
8	285.8	272.6	259.9
6	285.8	284.5	271.0

Anti-Ice Adjustments

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG)										
	PRESSURE ALTITUDE (1000 FT)										
	8	10	12	14	16	18	20	22	24	26	28
ENGINE ONLY	-0.5	-1.1	-1.1	-0.8	-0.6	-0.2	-0.4	-1.0	-0.9	-1.0	-1.1
ENGINE AND WING	-4.2	-4.8	-4.4	-3.5	-3.5	-3.1	-3.0	-4.2	-4.0	-3.8	-3.8

ALL ENGINES**Long Range Cruise Critical Fuel Reserves****Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
286	263	244	227	213	200	189	179	170	161	154
571	526	487	454	425	400	377	357	339	323	308
856	789	731	681	638	600	566	536	509	484	462
1141	1051	975	909	851	800	755	715	678	646	616
1426	1314	1218	1136	1064	1000	944	893	848	807	770
1711	1577	1462	1363	1276	1200	1132	1072	1018	969	924
1996	1840	1706	1590	1489	1400	1321	1251	1187	1130	1078
2282	2102	1949	1817	1702	1600	1510	1429	1357	1291	1232
2567	2365	2193	2044	1914	1800	1699	1608	1526	1453	1386

Critical Fuel (1000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)					
	160	180	200	220	240	260
200	4.7	5.0	5.2	5.4	5.6	5.9
300	6.5	6.8	7.1	7.4	7.8	8.1
400	8.3	8.7	9.1	9.5	9.9	10.3
500	10.0	10.6	11.0	11.5	12.0	12.5
600	11.8	12.5	13.0	13.5	14.1	14.6
700	13.6	14.3	14.9	15.5	16.2	16.8
800	15.3	16.1	16.9	17.5	18.2	18.9
900	17.0	18.0	18.8	19.4	20.3	21.1
1000	18.7	19.8	20.7	21.4	22.4	23.3
1100	20.4	21.6	22.6	23.4	24.4	25.4
1200	22.2	23.4	24.5	25.3	26.5	27.5
1300	23.8	25.2	26.4	27.3	28.5	29.6
1400	25.5	27.0	28.3	29.3	30.5	31.7
1500	27.2	28.7	30.2	31.2	32.5	33.8
1600	28.9	30.5	32.0	33.2	34.5	35.9
1700	30.5	32.3	33.9	35.1	36.5	38.0
1800	32.2	34.0	35.7	37.0	38.5	40.0

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft. 15 minute hold at 1500 ft. One missed approach; approach and land. Includes 5% allowance for wind errors.

Increase fuel required 0.8% for each 10°C above ISA.

If icing conditions exist, increase fuel required by 6% to account for engine and wing anti-ice on (3%) and ice accumulation on unheated surfaces (3%).

Allowance for performance deterioration not included.

Compare the fuel required for all engine and engine inoperative critical fuel reserves and use the higher of the two.

ENGINE INOP

**Long Range Cruise Critical Fuel Reserves
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
287	264	245	228	213	200	189	178	169	161	153
577	530	490	456	426	400	377	356	338	321	306
866	795	735	684	639	600	565	534	507	482	459
1155	1061	981	912	852	800	754	712	675	642	612
1444	1326	1226	1140	1066	1000	942	890	844	803	765
1733	1592	1472	1368	1279	1200	1130	1069	1013	963	918
2022	1857	1717	1596	1492	1400	1319	1247	1182	1123	1071
2311	2123	1962	1825	1705	1600	1507	1425	1351	1284	1224
2600	2388	2208	2053	1918	1800	1696	1603	1519	1444	1376

Critical Fuel (1000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)					
	160	180	200	220	240	260
200	4.5	4.7	5.0	5.3	5.6	5.8
300	6.2	6.5	6.9	7.3	7.7	8.1
400	7.9	8.3	8.8	9.3	9.8	10.3
500	9.6	10.1	10.7	11.3	11.9	12.5
600	11.3	11.9	12.6	13.3	14.0	14.7
700	13.0	13.7	14.4	15.2	16.0	16.9
800	14.6	15.4	16.3	17.2	18.1	19.0
900	16.3	17.2	18.1	19.1	20.2	21.2
1000	17.9	18.9	20.0	21.1	22.2	23.3
1100	19.6	20.7	21.8	23.0	24.2	25.5
1200	21.2	22.4	23.6	24.9	26.2	27.6
1300	22.8	24.1	25.4	26.8	28.2	29.7
1400	24.5	25.8	27.2	28.7	30.2	31.8
1500	26.1	27.5	29.0	30.6	32.2	33.9
1600	27.7	29.2	30.8	32.5	34.2	35.9
1700	29.3	30.9	32.6	34.4	36.2	38.0
1800	30.9	32.6	34.3	36.2	38.1	40.1

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft. 15 minute hold at 1500 ft. One missed approach; approach and land. Includes APU fuel burn and 5% allowance for wind errors.

Increase fuel required 0.8% for each 10°C above ISA.

If icing conditions exist, increase fuel required by 7% to account for engine and wing anti-ice on (1%) and ice accumulation on unheated surfaces (6%).

Allowance for performance deterioration not included.

Compare the fuel required for all engine and engine inoperative critical fuel reserves and use the higher of the two.

Performance Dispatch**Chapter PD****Landing****Section 12****Landing Field Limit Weight****Flaps 30****Wind Corrected Field Length (M)**

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)				
	-10	0	10	20	30
1000	780	1000	1080	1150	1230
1100	880	1100	1180	1260	1340
1200	970	1200	1280	1360	1450
1300	1060	1300	1390	1470	1560
1400	1150	1400	1490	1580	1670
1500	1240	1500	1590	1680	1780
1600	1330	1600	1690	1790	1880
1700	1430	1700	1800	1890	1990
1800	1520	1800	1900	2000	2100
1900	1610	1900	2000	2100	2210
2000	1700	2000	2100	2210	2330
2100	1790	2100	2210	2320	2440
2200	1880	2200	2310	2430	2550
2300	1970	2300	2420	2530	2670
2400	2060	2400	2520	2640	2780
2500	2140	2500	2630	2750	2900
2600	2230	2600	2730	2860	3010
2700	2320	2700	2840	2970	3130
2800	2410	2800	2940	3080	3240
2900	2500	2900	3050	3190	3360

Field Limit Weight (1000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)							
	0		1000		2000		3000	
	DRY	WET	DRY	WET	DRY	WET	DRY	WET
1100	125	102	122	99	118	96	114	93
1200	142	116	137	113	133	109	129	106
1300	158	130	153	126	149	122	144	119
1400	174	144	169	140	164	136	159	132
1500	191	159	186	154	180	149	175	145
1600	208	173	202	168	196	163	190	158
1700	223	187	218	182	212	177	206	171
1800	233	202	229	196	225	190	220	185
1900	243	217	238	211	234	204	230	198
2000	252	227	248	223	243	218	239	212
2100	261	236	257	232	252	228	248	223
2200	270	244	266	240	261	236	256	231
2300	279	252	275	248	270	243	265	239
2400	289	260	283	256	278	251	273	247
2500	298	268	292	263	287	259	282	254
2600	307	276	301	271	296	266	290	261
2700	316	284	310	279	304	274	298	269

Decrease field limit weight 10500 kg for each deactivated brake.

Decrease field limit weight 22000 kg when using manual speed brakes.

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 LB)				
		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	525.5				
52	126	538.5				
50	122	551.8	511.2			
48	118	565.4	524.0			
46	115	578.9	536.8	496.9		
44	111	592.8	549.6	508.3		
42	108	608.9	562.8	520.5	481.7	
40	104	625.8	577.1	533.2	493.8	
38	100	641.3	591.9	546.0	505.9	462.5
36	97	656.3	607.1	559.0	515.4	470.9
34	93	668.4	619.0	569.4	524.9	479.5
32	90	678.5	628.7	578.4	534.6	487.0
30	86	689.1	638.6	587.9	543.8	494.0
28	82	689.3	648.3	597.4	551.8	501.3
26	79	689.8	657.8	605.8	560.8	509.4
24	75	690.2	658.0	613.7	570.3	517.6
22	72	690.7	658.3	620.8	576.9	526.6
20	68	691.1	658.7	621.2	582.0	535.0
18	64	691.5	658.9	621.4	586.6	541.0
16	61	691.8	659.4	621.4	586.8	544.9
14	57	692.2	659.6	621.7	587.0	548.5
12	54	692.6	659.8	621.9	587.0	548.5
10	50	693.1	660.0	622.1	587.3	548.7
-40	-40	694.8	661.8	623.0	587.5	548.5

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.

With engine bleed for packs off, increase weight by 5400 lb.

With engine and wing anti-ice on, decrease weight by 4800 lb.

When operating in icing conditions during any part of the flight with forecast landing temperature below 50°F, decrease weight by 44400 lb.

ENGINE INOP**Go-Around Climb Gradient****Flaps 20, Gear Up****Based on engine bleed for packs on and anti-ice off.**

OAT (°C)	REFERENCE GO-AROUND GRADIENT (%)					
	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
54	3.00					
50	3.91	2.64				
46	4.67	3.64	2.14			
42	5.38	4.38	3.12	1.67		
38	6.10	5.09	3.80	2.60	1.18	
34	6.61	5.81	4.46	3.23	2.09	0.94
39	6.78	6.35	5.11	3.83	2.67	1.59
26	6.80	6.52	5.65	4.44	3.21	2.09
22	6.82	6.54	6.17	4.96	3.77	2.54
18	6.84	6.56	6.19	5.47	4.24	2.98
14	6.87	6.58	6.20	5.48	4.69	3.40
10	6.89	6.60	6.22	5.50	4.70	3.81

Weight Adjustment

WEIGHT (1000 KG)	REFERENCE GO-AROUND GRADIENT (%)							
	1	2	3	4	5	6	7	8
220	-1.96	-2.15	-2.34	-2.54	-2.73	-2.92	-3.11	-3.31
200	-1.09	-1.20	-1.31	-1.42	-1.53	-1.64	-1.74	-1.84
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	1.40	1.54	1.68	1.81	1.95	2.09	2.23	2.37
140	3.22	3.54	3.87	4.19	4.52	4.85	5.18	5.51

Speed Adjustment

SPEED (KIAS)	WEIGHT ADJUSTED GO-AROUND GRADIENT (%)								
	0	1	2	3	4	5	6	7	8
VREF	-0.26	-0.27	-0.27	-0.28	-0.28	-0.28	-0.27	-0.27	-0.26
VREF+5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VREF+10	0.16	0.16	0.16	0.16	0.15	0.14	0.14	0.14	0.14
VREF+20	0.31	0.30	0.29	0.28	0.24	0.21	0.18	0.18	0.19
VREF+30	0.30	0.25	0.21	0.17	0.09	0.02	-0.02	-0.03	-0.02

With engine bleed for packs off, increase gradient by 0.1%.**With engine anti-ice on, decrease gradient by 0.1%.****With engine and wing anti-ice on, decrease gradient by 0.2%.****When operating in icing conditions during any part of the flight with forecast landing temperatures below 10°C, decrease gradient by 0.6%.**

Quick Turnaround Limit Weight

Flaps 30 Limit Weight (1000 KG)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	233.4				
50	122	234.9	226.0			
45	113	236.9	228.0	219.2		
40	104	238.9	229.9	221.0	212.6	
35	95	241.0	231.9	222.9	214.4	206.0
30	86	243.1	233.9	224.9	216.2	207.8
25	77	245.4	236.0	227.0	218.0	209.6
20	68	247.6	238.2	229.0	219.9	211.4
15	59	250.0	240.4	231.1	221.9	213.3
10	50	252.4	242.7	233.3	224.1	215.2
5	41	254.9	245.1	235.6	226.2	217.2
0	32	257.4	247.5	237.9	228.5	219.2
-5	23	259.9	250.1	240.3	230.8	221.4
-10	14	262.6	252.7	242.7	233.1	223.6
-15	5	265.3	255.3	245.3	235.5	226.0
-20	-4	268.1	258.0	247.9	238.0	228.4
-30	-22	273.9	263.6	253.5	243.3	233.4
-40	-40	280.0	269.6	259.3	248.9	238.7
-50	-58	286.0	275.6	265.3	254.9	
-54	-65	288.4	278.0	267.6	257.3	

Increase weight 2500 kg per 1% uphill slope. Decrease weight 4100 kg per 1% downhill slope.

Increase weight 6500 kg per 10 kts Headwind. Decrease weight 29000 kg per 10 kts tailwind.

Decrease weight 11800 kg with one brake deactivated. Decrease weight 24200 kg with two brakes deactivated.

After landing at weights exceeding those shown above, adjusted for slope and wind, wait at least 65 minutes and check that wheel thermal plugs have not melted before executing a takeoff.

As an alternate procedure, if the BRAKE TEMP advisory message on EICAS is not displayed 10 to 15 minutes after parking, then no waiting period is required.

Performance Dispatch

Chapter PD

Gear Down

Section 13

GEAR DOWN

Takeoff/Landing Climb Limit Weight

AIRPORT OAT		CLIMB LIMIT WEIGHT (1000 KG)			
		AIRPORT PRESSURE ALTITUDE (FT)			
°C	°F	0	1000	2000	3000
54	129	150.0	148.8	153.4	152.6
52	126	153.0	149.4	153.4	155.9
50	122	156.3	152.7	154.2	155.8
48	118	159.7	156.1	157.8	156.5
46	115	163.4	159.7	161.4	159.8
44	111	167.2	163.4	165.2	163.3
42	108	171.2	167.1	168.9	166.8
40	104	175.1	171.0	172.6	170.4
38	100	178.9	174.7	176.2	174.0
36	97	182.7	178.5	180.0	177.5
34	93	186.5	182.4	183.9	181.2
32	90	190.6	186.3	187.7	184.9
30	86	194.7	190.3	191.6	188.6
28	82	198.7	194.4	195.6	192.4
26	79	202.8	198.6	199.7	196.3
24	75	205.1	202.8	203.7	200.2
22	72	205.2	205.0	207.7	204.0
20	68	205.3	205.2	209.8	207.9
18	64	205.3	205.3	210.0	209.7
16	61	205.4	205.5	210.2	209.8
14	57	205.5	205.7	210.3	209.9
12	54	205.6	205.9	210.5	209.9
10 & BELOW	50 & BELOW	205.7	206.1	210.7	210.0

With engine bleed for packs off, increase weight by 700 kg.
With engine anti-ice on, decrease weight by 1650 kg.
With engine and wing anti-ice on, decrease weight by 4000 kg.

GEAR DOWN

Takeoff Obstacle Limit Weight

Flaps 15

Sea Level, 33°C & Below, Zero Wind

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	227.9	246.2	257.8								
20	208.0	224.1	236.9	247.1	254.8	259.7					
40	190.8	205.7	218.7	229.2	237.7	245.0	250.8	254.7	257.9	260.6	262.9
60	177.9	193.0	205.7	216.3	225.0	232.2	238.1	243.2	248.7	251.9	254.6
80	168.0	183.0	195.4	205.8	214.7	222.1	228.4	233.8	238.4	242.5	246.7
100	159.3	174.4	186.8	197.1	205.9	213.5	220.1	225.7	230.6	234.8	238.6
120	151.2	167.0	179.2	189.5	198.3	205.9	212.6	218.5	223.5	228.0	232.0
140		160.3	172.5	182.8	191.6	199.2	205.9	211.9	217.2	221.8	226.0
160		154.0	166.4	176.7	185.5	193.2	199.9	206.0	211.3	216.1	220.4
180		148.1	160.9	171.1	179.9	187.7	194.5	200.5	206.0	210.9	215.3
200			155.7	166.0	174.8	182.6	189.5	195.6	201.0	205.9	210.5
220			150.8	161.3	170.1	177.8	184.8	190.9	196.4	201.4	205.9
240			146.2	156.9	165.7	173.4	180.3	186.6	192.1	197.1	201.7
260				152.7	161.6	169.3	176.2	182.4	188.1	193.1	197.7
280				148.7	157.8	165.4	172.3	178.6	184.2	189.4	194.0
300					154.1	161.7	168.6	174.9	180.6	185.7	190.5

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustment

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
33 & BELOW	0	0	0	0	0	0	0
34	-1.2	-1.5	-1.7	-2.0	-2.3	-2.6	-2.9
36	-3.1	-3.9	-4.6	-5.4	-6.1	-6.9	-7.6
38	-5.1	-6.3	-7.5	-8.7	-10.0	-11.2	-12.4
40	-7.1	-8.7	-10.4	-12.1	-13.8	-15.5	-17.1
42	-9.4	-11.7	-13.9	-16.1	-18.4	-20.6	-22.8
44	-11.8	-14.6	-17.4	-20.2	-23.0	-25.8	-28.6
46	-14.1	-17.5	-20.8	-24.2	-27.5	-30.9	-34.3
48	-16.4	-20.4	-24.3	-28.2	-32.1	-36.0	-40.0
50	-18.8	-23.3	-27.7	-32.2	-36.7	-41.2	-45.7

Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	140	160	180	200	220	240	260	280
S.L. & BELOW	0	0	0	0	0	0	0	0
1000	-3.3	-4.1	-4.8	-5.6	-6.3	-7.0	-7.8	-8.5
2000	-7.3	-8.6	-9.9	-11.2	-12.5	-13.8	-15.1	-16.4
3000	-12.0	-14.3	-16.7	-19.0	-21.3	-23.6	-25.9	-28.3

GEAR DOWN

Takeoff Obstacle Limit Weight

Flaps 15

Wind Adjustment

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	140	160	180	200	220	240	260	280
15 TW	-18.6	-19.5	-20.3	-21.2	-22.0	-22.9	-23.8	-24.6
10 TW	-12.4	-13.0	-13.5	-14.1	-14.7	-15.3	-15.8	-16.4
5 TW	-6.2	-6.5	-6.8	-7.1	-7.3	-7.6	-7.9	-8.2
0	0	0	0	0	0	0	0	0
10 HW	4.0	3.6	3.2	2.9	2.5	2.1	1.8	1.4
20 HW	8.0	7.2	6.5	5.7	5.0	4.3	3.5	2.8
30 HW	12.0	10.9	9.8	8.7	7.6	6.4	5.3	4.2
40 HW	16.1	14.6	13.1	11.6	10.1	8.6	7.1	5.6

Long Range Cruise Altitude Capability

Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
250	19200	16600	13800
240	20900	18400	15600
230	22600	20200	17600
220	24500	22000	19600
210	26100	24300	21400
200	27800	26400	23800
190	29500	28500	26400
180	30900	30500	28900
170	32100	32000	31200
160	33400	33300	32900
150	34800	34700	34600
140	36100	36100	36100

GEAR DOWN

**Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
342	301	267	240	219	200	187	175	165	156	148
515	454	401	361	328	300	280	263	247	233	221
688	605	535	481	438	400	374	350	329	311	295
859	756	669	601	547	500	467	438	411	388	368
1029	906	802	721	656	600	561	525	494	466	442
1198	1056	935	841	766	700	654	613	576	544	515
1365	1204	1068	961	875	800	748	701	658	621	589
1532	1353	1200	1080	984	900	841	788	741	699	663
1698	1500	1331	1199	1093	1000	935	876	823	777	737
1863	1647	1463	1318	1202	1100	1028	964	906	855	811
2027	1794	1594	1437	1310	1200	1122	1052	989	934	886
2190	1939	1725	1556	1419	1300	1216	1140	1072	1012	960
2353	2085	1855	1674	1528	1400	1309	1228	1155	1090	1035
2515	2229	1985	1793	1636	1500	1403	1316	1238	1169	1110
2675	2373	2115	1911	1745	1600	1497	1404	1321	1247	1184
2836	2517	2244	2029	1853	1700	1591	1492	1404	1326	1259
2995	2660	2373	2146	1961	1800	1684	1580	1487	1405	1334
3154	2803	2502	2264	2070	1900	1778	1668	1570	1484	1409
3312	2946	2631	2382	2178	2000	1872	1756	1653	1563	1484
3469	3087	2760	2499	2286	2100	1966	1845	1737	1642	1560
3626	3229	2888	2616	2394	2200	2060	1933	1820	1721	1635
3782	3370	3015	2733	2502	2300	2154	2022	1904	1800	1710
3937	3510	3142	2850	2610	2400	2248	2111	1988	1880	1786
4092	3650	3270	2966	2717	2500	2342	2199	2072	1959	1861
4246	3789	3397	3083	2825	2600	2436	2288	2156	2039	1937
4399	3929	3523	3199	2933	2700	2530	2377	2240	2118	2013

GEAR DOWN**Long Range Cruise Trip Fuel and Time****Reference Fuel and Time Required**

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	6.6	0:54	6.4	0:51	6.0	0:49	5.8	0:47	5.7	0:46
300	9.8	1:19	9.3	1:15	8.7	1:10	8.3	1:07	8.2	1:05
400	13.1	1:44	12.3	1:39	11.4	1:32	10.8	1:28	10.6	1:24
500	16.3	2:09	15.3	2:02	14.2	1:53	13.4	1:48	13.0	1:43
600	19.5	2:34	18.3	2:26	16.9	2:15	15.9	2:08	15.4	2:02
700	22.8	2:58	21.4	2:49	19.7	2:36	18.5	2:28	17.9	2:21
800	26.2	3:22	24.5	3:12	22.4	2:57	21.1	2:48	20.4	2:40
900	29.5	3:47	27.6	3:35	25.2	3:19	23.7	3:08	22.9	2:58
1000	32.9	4:11	30.7	3:58	28.0	3:40	26.3	3:28	25.5	3:17
1100	36.3	4:34	33.9	4:20	30.9	4:01	29.0	3:48		
1200	39.8	4:58	37.1	4:43	33.8	4:21	31.7	4:07		
1300	43.3	5:21	40.3	5:05	36.6	4:42	34.4	4:27		
1400	46.7	5:45	43.5	5:27	39.5	5:03	37.2	4:47		
1500	50.3	6:07	46.9	5:49	42.5	5:23	40.0	5:06		
1600	53.9	6:30	50.2	6:11	45.5	5:43	42.8	5:25		
1700	57.5	6:53	53.5	6:32	48.5	6:03	45.6	5:45		
1800	61.1	7:15	56.9	6:54	51.5	6:24	48.5	6:04		
1900	64.8	7:37	60.3	7:15	54.6	6:43	51.4	6:23		
2000	68.6	7:60	63.8	7:36	57.7	7:03	54.3	6:42		

Fuel Required Adjustments (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	140	160	180	200	220
10	-0.6	0.0	0.6	1.3	2.1
15	-0.8	0.0	0.9	2.0	3.1
20	-1.1	0.0	1.2	2.7	4.2
25	-1.3	0.0	1.5	3.4	5.4
30	-1.6	0.0	1.9	4.1	6.6
35	-1.9	0.0	2.2	4.9	7.8
40	-2.2	0.0	2.6	5.7	9.1
45	-2.5	0.0	2.9	6.5	10.5
50	-2.8	0.0	3.3	7.3	11.9
55	-3.1	0.0	3.7	8.1	13.4
60	-3.5	0.0	4.2	9.0	14.9
65	-3.8	0.0	4.6	9.9	16.5
70	-4.1	0.0	5.0	10.9	18.2
75	-4.4	0.0	5.5	11.8	19.9
80	-4.7	0.0	5.9	12.8	21.6

Based on VREF+80 climb, Long Range Cruise and VREF+80 descent.

GEAR DOWN

**Short Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
101	84	72	63	56	50	45	42	38	36	33
173	151	134	120	109	100	92	86	80	75	70
247	218	196	178	163	150	139	130	121	114	108
319	285	258	235	216	200	186	174	163	154	146
391	351	319	292	269	250	233	218	206	194	184
462	417	380	349	323	300	280	263	248	234	222
534	483	441	406	376	350	327	308	290	274	260
606	549	502	463	429	400	375	352	332	315	299
678	615	564	520	482	450	422	397	374	355	337
751	682	625	577	536	500	469	441	417	395	375

Trip Fuel and Time

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		140	160	180	200	220	
50	FUEL (1000 KG)	1.8	1.9	2.1	2.2	2.4	0:15
	ALT (FT)	12000	12000	10000	10000	8000	
100	FUEL (1000 KG)	3.1	3.3	3.6	3.8	4.1	0:25
	ALT (FT)	24000	22000	18000	18000	16000	
150	FUEL (1000 KG)	4.2	4.6	4.9	5.3	5.7	0:35
	ALT (FT)	30000	26000	24000	22000	22000	
200	FUEL (1000 KG)	5.3	5.8	6.3	6.8	7.3	0:45
	ALT (FT)	32000	28000	26000	24000	22000	
250	FUEL (1000 KG)	6.3	6.9	7.6	8.2	8.8	0:54
	ALT (FT)	32000	30000	28000	26000	24000	
300	FUEL (1000 KG)	7.4	8.1	8.9	9.6	10.4	1:03
	ALT (FT)	32000	30000	28000	26000	24000	
350	FUEL (1000 KG)	8.4	9.3	10.2	11.0	12.0	1:12
	ALT (FT)	32000	30000	28000	26000	24000	
400	FUEL (1000 KG)	9.5	10.5	11.5	12.5	13.5	1:21
	ALT (FT)	32000	30000	28000	26000	24000	
450	FUEL (1000 KG)	10.6	11.7	12.8	13.9	15.1	1:31
	ALT (FT)	32000	30000	28000	26000	24000	
500	FUEL (1000 KG)	11.6	12.9	14.1	15.4	16.7	1:40
	ALT (FT)	32000	30000	28000	26000	24000	

GEAR DOWN

**Holding Planning
Flaps Up**

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)							
	PRESSURE ALTITUDE (FT)							
	1500	5000	10000	15000	20000	25000	30000	35000
260	11680	11330	11320	11410				
240	10880	10590	10530	10560	10720			
220	10110	9900	9760	9760	9800	10180		
200	9360	9220	9020	8960	8930	9160		
180	8630	8530	8310	8190	8310	8260	8680	
160	8070	7980	7760	7590	7570	7380	7630	
140	7320	7250	7050	6860	6820	6730	6740	7130

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
260	11060	10760	10760	10870	11050
240	10250	10040	9970	10030	10110
220	9450	9340	9190	9190	9200
200	8670	8610	8430	8360	8340
180	8070	8030	7820	7720	7730
160	7300	7270	7070	6940	6950
140	6540	6510	6330	6200	6190

These tables include 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight
Based on engine bleed for packs on and anti-ice off

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
18	150		
16	159	154	148
14	169	162	154
12	178	170	162
10	187	178	170
8	191	182	174
6	199	190	182
4	207	199	190

With engine anti-ice on, decrease level off weight by 1200 kg.
With engine and wing anti-ice on, decrease level off weight by 3600 kg.

Performance Dispatch**Text****Chapter PD****Section 14****Introduction**

This chapter contains self dispatch performance data intended primarily for use by flight crews in the event that information cannot be obtained from the airline dispatch office. The data provided is for a single takeoff flap at max takeoff thrust. The range of conditions covered is limited to those normally encountered in airline operation. To satisfy JAA requirements, data is provided when appropriate for wet runway operations. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

Takeoff

The maximum allowable takeoff weight will be the least of the Field, Climb and Obstacle Limit Weights as determined from the following tables. Tire and Brake Energy Limits are not shown as they are not limiting for the range of conditions shown in this chapter. When determining a maximum weight for a wet runway, the dry runway limit weight must also be checked and the lower of the two weights used.

Regulations require that the runway length be adjusted to account for alignment of the airplane prior to takeoff. The table below provides TORA, TODA and ASDA adjustments for both 90 degree taxiway entry and 180 degree turnaround. For the 180 degree turnaround case, adjustments are provided for a nominal 60 m runway pavement width. These values may be used when obtaining takeoff weights from the AFM or a takeoff analysis program. When using line-up allowances with the Field Length Limit chart, the field length available must be reduced by the ASDA adjustment.

	90 DEGREE TAXIWAY ENTRY	180 DEGREE TURNAROUND
	MINIMUM LINE-UP DISTANCE (M)	NOMINAL LINE-UP DISTANCE (M) (60.0 M RUNWAY)
TORA & TODA	23	51
ASDA	49	77

Field Limit Weight - Slope and Wind Corrections

These tables for wet and dry runways provide corrections to the field length available for the effects of runway slope and wind component along the runway. Enter the Slope Correction table with the available field

length and runway slope to determine the slope corrected field length. Now enter the Wind Correction table with slope corrected field length and wind component to determine the slope and wind corrected field length.

Field and Climb Limit Weight

Tables are presented for selected airport pressure altitudes and runway condition and show both Field and Climb Limit Weights. Enter the appropriate table for pressure altitude and runway condition with "Slope and Wind Corrected Field Length" determined above and airport OAT to obtain Field Limit Weight. Also read Climb Limit Weight for the same OAT. Intermediate altitudes may be interpolated or use next higher altitude.

When finding a maximum weight for a wet runway, the dry runway limit weight must also be determined and the lower of the two weights used.

Obstacle Limit Weight

This table provides obstacle limit weights for reference airport conditions based on obstacle height above the runway surface and distance from brake release. Enter the correction tables to correct the reference Obstacle Limit Weight for the effects of OAT, pressure altitude and wind as indicated. In the case of multiple obstacles, enter the tables successively with each obstacle and determine the most limiting weight.

When using line-up allowances with the Obstacle Limit chart, the obstacle distance from brake release must be reduced by the ASDA adjustment.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table as well as FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred

method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Normal takeoff speeds, V1, VR, and V2 are read from either the wet or dry table by entering with takeoff flap setting and brake release weight. Use the tables provided to correct takeoff speeds for altitude and actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind corrections to V1 are obtained by entering the Slope and Wind V1 Adjustment Table.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than the minimum V1 for control on the ground, V1(MCG). It is therefore necessary to compare the adjusted V1 to V1(MCG). To find V1(MCG), enter the V1(MCG) table with airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than V1(MCG), set VR equal to V1(MCG) and determine a new V2 by adding the difference between the normal VR and V1(MCG) to the normal V2. No weight adjustment is required provided that the field length available exceeds the minimum field length required shown in the Field and Climb Limit Weight table.

Brakes Deactivated

When operating with brakes deactivated, the field limit weight and the V1 must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway limited weight by 3100 kg for a dry runway or 2050 kg for a wet runway and the V1 associated with the reduced weight by one knot. With two brakes deactivated, reduce the normal runway limited weight by 6650 kg for a dry runway or 4200 kg for a wet runway and the V1 associated with the reduced weight by two knots. If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the dry accelerate stop distance corrected for wind and slope exceeds approximately 1740m for one brake deactivated or 1830 m for two brakes deactivated. For wet runways, the corrected accelerate stop distance should exceed approximately 2140m for one brake deactivated or 2230 m for two brakes deactivated.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

One Thrust Reverser Inoperative

Wet runway takeoff performance presented for all brakes operating is based on the use of one thrust reverser during deceleration. When operating with a thrust reverser inoperative, the runway/obstacle limited takeoff weight and V1 speed must be reduced to account for the reduced deceleration capability. A simplified method which conservatively accounts for this is to reduce the normal wet runway/obstacle limited weight by 5400 kg and the V1 associated with the reduced weight by the amount shown in the table below.

THRUST REVERSER INOPERATIVE V1 ADJUSTMENTS	
FIELD LENGTH (M)	V1 ADJUSTMENTS (KIAS)
2000	- 4
2500	- 4
3000	- 3
3500	- 3
4000	- 3
4500	- 3

If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate stop distance available corrected for wind and slope exceeds approximately 2200 m.

Enroute

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination. Data is based on economy climb and descent speeds, and Long Range Cruise with normal engine bleed for air conditioning. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine trip fuel and time for a constant altitude cruise, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time Table with air distance from the Ground to Air Miles Conversion Table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment Table with the Reference Fuel and the planned landing weight to obtain fuel required at the planned landing weight.

Long Range Cruise Step Climb Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination when flying a step climb profile. Step climb profiles are based on 4000 ft step climbs to keep the flight within 2000 ft of the optimum altitude for the current cruise weight. To determine trip fuel and time, enter the Ground to Air Miles Conversion table and determine air distance as discussed above. Then enter the Trip Fuel and Time required with air distance and planned landing weight to read trip fuel. Continue across the table to read trip time.

Short Trip Fuel and Time

These tables are provided to determine trip fuel and time for short distances or alternates. The data considers the use of the FMC short trip optimum altitude. Obtain air distance from upper table using the ground distance and wind component to the alternate. Enter Trip Fuel and Time table with air distance and read trip fuel required for the expected landing weight, together with time to alternate at right. For distances greater than shown or other altitudes, use the Long Range Cruise Trip Fuel and Time tables.

Holding Planning

These tables provide total fuel flow information necessary for planning Flaps Up and Flaps 1 holding and reserve fuel requirements. Data is based on the FMC holding speed schedule which is the higher of the maximum endurance and flaps up maneuver speeds. As noted, the fuel flow is based on flight in a racetrack holding pattern. For holding in straight and level flight, reduce table values by 5%.

Oxygen Requirements

Flight Crew System

Regulations require that sufficient oxygen be provided to the flight crew to account for the greater of supplemental breathing oxygen in the event of a cabin depressurization or protective breathing in the event of smoke or harmful fumes in the flight deck.

Tables are provided to determine the flight crew oxygen dispatch requirements. Table 1 shows minimum oxygen quantity necessary to ensure that protective breathing requirements are satisfied. Table 2 shows the supplemental oxygen requirement for loss of pressurization, emergency descent and total post decompression flight time above 10000 ft. Table 3 gives adjustments that must be applied to Table 2 crew member supplemental requirements in situations where the enroute altitude after decompression will exceed 14000 ft. The increments shown in Table 3 reflect only the increase in oxygen flow rate associated with periods of post decompression flight at altitudes other than 14000 ft. Hence, this time must also be included in the Table 2 time value used.

Table 1, Table 2 and Table 3 values are based on “NORMAL” regulator settings. Table 3 also shows “100%” regulator setting adjustments that can be used if the operator chooses to schedule oxygen dispatch requirements based on pure oxygen availability.

Additional adjustments for more extensive than normal crew usage can be made by adding 2.05 liters/person/minute (1.2 psi/person/minute for the single cylinder system) or 13 liters/person/minute (8 psi/person/minute) if 100% oxygen is selected during normal usage.

After determining the total volume (liters) required for the flight crew by using the larger value from Table 1 or Table 2, obtain the dispatch pressure required from the Cylinder Volume to Pressure Conversion table (Table 4). Adjust this reading for cylinder temperature as required, using the adjustments given (Table 5).

Net Level Off Weight

The Net Level Off Weight table is provided to determine terrain clearance capability in straight and level flight following an engine failure. Regulations require terrain clearance planning based on net performance which is the gross (or actual) gradient performance degraded by 1.1%. In addition, the net level off pressure altitude must clear the terrain by 1000 ft.

To determine the maximum weight for terrain clearance, enter the table with required net level off pressure altitude and expected ISA deviation to obtain weight. Adjust weight for anti-ice operation as noted below the table.

Extended Range Operations

Regulations require that flights conducted over a route that contains a point further than one hour's time at "normal one engine inoperative speed" from an adequate diversion airport comply with rules set up specifically for "Extended Range Operation with Two Engine airplanes". This section provides reserve fuel planning information for the "Critical Fuel Scenario" based on two engine operation at Long Range Cruise as well as single engine operation at Long Range Cruise.

Long Range Cruise Critical Fuel Reserves

Enter Ground to Air Mile Conversion table with forecast wind and ground distance to diversion airport from critical point to obtain air distance. Now enter Critical Fuel table with air distance and expected weight at the critical point and read required fuel. Apply the noted fuel adjustments as necessary. Regulations require a 5% allowance for performance deterioration unless a value has been established by the operator for in-service deterioration.

As noted below each table, the fuel required is the greater of the two engine fuel and the single engine fuel. This fuel is compared to the amount of fuel normally onboard the airplane at that point in the route. If the fuel required by the critical fuel reserves exceeds the amount of fuel normally expected, the fuel load must be adjusted accordingly.

Landing

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for Flaps 30.

Maximum landing weight is the lowest of the field length limit weight, climb limit weight or maximum certified landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required.

Go-Around Climb Gradient

Enter the Reference Go-around Gradient table with airport OAT and pressure altitude to determine the reference Go-Around Gradient. Then adjust the reference gradient for airplane weight and speed using the tables provided to determine the weight and speed adjusted Go-Around Gradient. Apply the necessary engine bleed corrections as noted. Note that data is for one engine inoperative.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted adjustments as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent takeoff, or ensure the brake temperature is within limits using the alternate procedure described on the page.

Gear Down

This section provides flight planning data for revenue operation with gear down.

Takeoff/Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to determine Takeoff Climb Limit Weight with gear down. Correct the weight obtained for engine bleed configuration as required.

The remaining gear down tables in this section are identical in format and usage to the corresponding gear up tables previously described.

Performance Dispatch**Chapter PD****Table of Contents****Section 20****777-200ER TRENT892 KG FAA**

Takeoff.....	PD.20.1
Takeoff Field Corrections	PD.20.1
Takeoff Field & Climb Limit Weights	PD.20.2
Takeoff Obstacle Limit Weight.....	PD.20.5
Brake Energy Limits VMBE	PD.20.7
Takeoff Speeds	PD.20.8
 Enroute	 PD.21.1
Long Range Cruise Maximum Operating Altitude	PD.21.1
Long Range Cruise Trip Fuel and Time	PD.21.3
Long Range Cruise Step Climb	PD.21.5
Short Trip Fuel and Time	PD.21.6
Holding Planning	PD.21.7
Crew Oxygen Requirements.....	PD.21.7
Net Level Off Weight	PD.21.8
Decompression Critical Fuel Reserves - LRC Cruise	PD.21.9
Driftdown Critical Fuel Reserves - LRC Driftdown/Cruise.....	PD.21.11
 Landing	 PD.22.1
Landing Field Limit Weight - Dry Runway	PD.22.1
Landing Field Limit Weight - Wet Runway	PD.22.2
Landing Climb Limit Weight	PD.22.3
Go-Around Climb Gradient	PD.22.4
Quick Turnaround Limit Weight.....	PD.22.5
 Gear Down.....	 PD.23.1
Takeoff Climb Limit Weight.....	PD.23.1
Landing Climb Limit Weight	PD.23.2
Takeoff Obstacle Limit Weight.....	PD.23.3
Long Range Cruise Altitude Capability	PD.23.4

Long Range Cruise Trip Fuel and Time	PD.23.5
Short Trip Fuel and Time	PD.23.7
Holding Planning	PD.23.8
Net Level Off Weight	PD.23.9
Text.	PD.24.1
Introduction	PD.24.1
Takeoff	PD.24.1
Enroute	PD.24.3
Landing	PD.24.6
Gear Down	PD.24.7

Performance Dispatch

Chapter PD

Takeoff

Section 20

Takeoff Field Corrections
Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH (M)								
	RUNWAY SLOPE (%)								
	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
1200	1220	1220	1210	1210	1200	1180	1150	1130	1100
1400	1450	1440	1420	1410	1400	1370	1330	1300	1270
1600	1670	1660	1640	1620	1600	1560	1520	1480	1430
1800	1900	1880	1850	1830	1800	1750	1700	1650	1600
2000	2120	2090	2060	2030	2000	1940	1880	1820	1760
2200	2340	2310	2270	2240	2200	2130	2060	2000	1930
2400	2560	2520	2480	2440	2400	2320	2250	2170	2090
2600	2780	2740	2690	2650	2600	2510	2430	2340	2260
2800	3000	2950	2900	2850	2800	2710	2610	2520	2420
3000	3220	3170	3110	3060	3000	2890	2790	2680	2580
3200	3440	3380	3320	3260	3200	3080	2970	2850	2730
3400	3660	3600	3530	3470	3400	3270	3140	3020	2890
3600	3880	3810	3740	3670	3600	3460	3320	3180	3040
3800	4100	4030	3950	3880	3800	3650	3500	3350	3200
4000	4320	4240	4160	4080	4000	3840	3680	3520	3360
4200	4540	4460	4370	4290	4200	4030	3860	3680	3510
4400	4760	4670	4580	4490	4400	4220	4030	3850	3670
4600	4980	4890	4790	4700	4600	4410	4210	4020	3820
4800	5200	5100	5000	4900	4800	4600	4390	4190	3980
5000	5420	5320	5210	5110	5000	4780	4570	4350	4140

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M)							
	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1200	840	960	1080	1200	1270	1350	1440	1530
1400	1000	1140	1270	1400	1480	1570	1660	1760
1600	1170	1310	1460	1600	1690	1780	1880	1980
1800	1340	1490	1650	1800	1900	2000	2100	2210
2000	1510	1670	1840	2000	2100	2210	2320	2440
2200	1680	1850	2030	2200	2310	2430	2540	2660
2400	1850	2030	2220	2400	2520	2640	2770	2890
2600	2010	2210	2400	2600	2730	2860	2990	3120
2800	2180	2390	2590	2800	2930	3070	3210	3350
3000	2350	2570	2780	3000	3140	3290	3430	3570
3200	2520	2750	2970	3200	3350	3500	3650	3800
3400	2690	2930	3160	3400	3560	3710	3870	4030
3600	2860	3100	3350	3600	3770	3930	4090	4250
3800	3030	3280	3540	3800	3970	4140	4310	4480
4000	3190	3460	3730	4000	4180	4360	4530	4710
4200	3360	3640	3920	4200	4390	4570	4750	4930
4400	3530	3820	4110	4400	4600	4790	4980	5160
4600	3700	4000	4300	4600	4800	5000	5200	5390
4800	3870	4180	4490	4800	5010	5220	5420	5610
5000	4040	4360	4680	5000	5220	5430	5640	5840

Takeoff Field & Climb Limit Weights**Flaps 15****Sea Level Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	°C	-40	14	18	22	23	25	27	29	30	40	50
	°F	-40	57	64	72	73	77	81	84	86	104	122
1470	224.7	204.2	202.9	201.6	201.3	200.6	200.0	199.4	198.7	189.0	175.5	
1600	235.2	213.9	212.6	211.3	210.9	210.3	209.6	209.0	208.3	198.2	184.2	
1800	249.8	227.5	226.1	224.7	224.3	223.7	223.0	222.3	221.6	211.0	196.4	
2000	263.2	240.0	238.5	237.1	236.7	236.0	235.3	234.6	233.9	222.8	207.7	
2200	275.7	251.7	250.2	248.7	248.3	247.6	246.9	246.2	245.3	233.9	218.2	
2400	287.6	262.8	261.2	259.7	259.3	258.5	257.8	257.0	256.2	244.4	228.2	
2600	298.9	273.4	271.7	270.1	269.7	268.9	268.2	267.4	266.5	254.4	237.6	
2800	309.8	283.5	281.8	280.2	279.8	279.0	278.2	277.4	276.5	264.0	246.7	
3000	317.5	292.6	290.9	289.2	288.8	287.9	287.1	286.3	285.4	272.5	254.7	
3200	317.5	301.1	299.3	297.6	297.1	296.3	295.5	294.6	293.7	280.5	262.3	
3400	317.5	309.2	307.3	305.6	305.1	304.3	303.4	302.6	301.6	288.1	269.5	
3600	317.5	316.9	315.0	313.2	312.8	311.9	311.0	310.1	309.2	295.4	276.4	
3800	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.3	316.3	302.3	283.0	
4000	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	309.0	289.3	
4200	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	315.3	295.3	
4400	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	301.1	
4600	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	306.6	
4800	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	311.9	
CLIMB LIMIT WT (1000 KG)	294.2	293.1	293.0	292.9	292.9	292.8	292.8	292.8	291.8	271.9	242.4	

2000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	°C	-40	14	18	22	23	25	27	29	30	40	50
	°F	-40	57	64	72	73	77	81	84	86	104	122
1470	211.3	191.9	190.7	189.5	189.2	188.6	187.3	185.7	184.9	175.4	162.9	
1600	221.4	201.2	199.9	198.7	198.4	197.7	196.4	194.8	193.9	184.1	171.1	
1800	235.3	214.2	212.8	211.5	211.2	210.6	209.2	207.5	206.6	196.2	182.7	
2000	248.1	226.2	224.8	223.4	223.1	222.4	221.0	219.2	218.3	207.5	193.4	
2200	260.1	237.4	236.0	234.5	234.2	233.5	232.0	230.1	229.2	218.0	203.4	
2400	271.5	248.0	246.5	245.0	244.7	243.9	242.4	240.5	239.5	228.0	212.9	
2600	282.3	258.1	256.5	255.0	254.6	253.9	252.3	250.3	249.3	237.4	221.9	
2800	292.7	267.8	266.2	264.6	264.2	263.5	261.8	259.8	258.7	246.5	230.5	
3000	302.1	276.4	274.8	273.1	272.7	272.0	270.3	268.2	267.1	254.5	238.0	
3200	310.8	284.5	282.8	281.2	280.8	279.9	278.2	276.1	275.0	262.1	245.2	
3400	317.5	292.0	290.5	288.8	288.4	287.6	285.8	283.6	282.5	269.3	252.0	
3600	317.5	299.6	297.8	296.1	295.7	294.9	293.1	290.8	289.7	276.2	258.6	
3800	317.5	306.6	304.8	303.1	302.6	301.8	300.0	297.7	296.5	282.8	264.9	
4000	317.5	313.3	311.5	309.7	309.2	308.4	306.5	304.2	303.0	289.1	270.8	
4200	317.5	317.5	317.5	316.0	315.6	314.7	312.8	310.5	309.3	295.1	276.6	
4400	317.5	317.5	317.5	317.5	317.5	317.5	317.5	316.5	315.3	300.9	282.1	
4600	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	306.4	287.3	
4800	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	311.7	292.3	
CLIMB LIMIT WT (1000 KG)	278.2	277.1	277.1	277.0	277.0	276.9	274.8	271.7	270.1	250.9	224.7	

With engine bleed for packs off, increase field limit weight by 280 kg and climb limit weight by 800 kg.

With engine anti-ice on, decrease field limit weight by 30 kg.

With engine and wing anti-ice on, decrease field limit weight by 750 kg and climb limit weight by 1250 kg.

Takeoff Field & Climb Limit Weights**Flaps 15****4000 FT Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	°C	-40	14	18	22	23	25	27	29	30	40	50
	°F	-40	57	64	72	73	77	81	84	86	104	122
1470	197.3	179.1	177.9	176.4	175.8	174.4	173.0	171.3	170.5	161.3	151.6	
1600	206.8	187.9	186.7	185.1	184.4	183.0	181.6	179.9	179.0	169.4	159.3	
1800	220.1	200.3	199.0	197.4	196.6	195.1	193.6	191.8	190.9	180.9	170.4	
2000	232.3	211.7	210.4	208.7	207.9	206.4	204.8	202.9	202.0	191.5	180.6	
2200	243.7	222.4	221.0	219.3	218.5	216.9	215.3	213.3	212.3	201.5	190.2	
2400	254.5	232.5	231.1	229.2	228.4	226.8	225.1	223.1	222.1	210.9	199.2	
2600	264.8	242.1	240.6	238.7	237.9	236.2	234.5	232.4	231.3	219.8	207.8	
2800	274.7	251.3	249.8	247.8	247.0	245.2	243.5	241.3	240.2	228.4	215.9	
3000	283.5	259.4	257.9	255.9	255.0	253.2	251.4	249.2	248.0	235.8	223.0	
3200	291.8	267.1	265.5	263.5	262.6	260.7	258.9	256.6	255.4	242.9	229.8	
3400	299.7	274.4	272.8	270.8	269.8	267.9	266.0	263.7	262.5	249.8	236.4	
3600	307.2	281.5	279.8	277.7	276.8	274.8	272.9	270.5	269.3	256.3	242.6	
3800	314.3	288.1	286.5	284.3	283.3	281.4	279.4	277.0	275.8	262.5	248.6	
4000	317.5	294.5	292.8	290.6	289.6	287.6	285.6	283.2	281.9	268.4	254.3	
4200	317.5	300.6	298.9	296.7	295.7	293.6	291.6	289.1	287.9	274.1	259.8	
4400	317.5	306.5	304.7	302.5	301.4	299.4	297.3	294.8	293.5	279.6	265.0	
4600	317.5	312.1	310.3	308.0	307.0	304.9	302.8	300.2	298.9	284.8	270.0	
4800	317.5	317.4	315.6	313.3	312.2	310.1	308.0	305.4	304.1	289.8	274.8	
CLIMB LIMIT WT (1000 KG)	259.6	258.6	258.6	257.6	256.5	254.1	251.5	248.3	246.7	228.8	209.8	

6000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	°C	-40	14	18	22	23	25	27	29	30	40	50
	°F	-40	57	64	72	73	77	81	84	86	104	122
1470	183.9	166.8	165.5	163.7	163.3	161.8	160.3	158.7	157.9	149.4	140.1	
1600	192.9	175.1	173.8	171.9	171.5	170.0	168.4	166.7	165.9	157.1	147.4	
1800	205.5	186.9	185.5	183.5	183.1	181.5	179.8	178.1	177.2	168.0	157.9	
2000	217.1	197.8	196.3	194.3	193.8	192.1	190.4	188.6	187.7	178.2	167.6	
2200	228.0	208.0	206.4	204.4	203.9	202.1	200.3	198.5	197.5	187.7	176.7	
2400	238.3	217.6	216.0	213.9	213.4	211.6	209.7	207.8	206.8	196.6	185.3	
2600	248.0	226.7	225.1	222.9	222.4	220.5	218.6	216.6	215.6	205.1	193.4	
2800	257.4	235.5	233.8	231.5	231.0	229.1	227.1	225.1	224.0	213.2	201.2	
3000	265.8	243.1	241.4	239.1	238.5	236.5	234.5	232.4	231.3	220.2	207.8	
3200	273.6	250.4	248.6	246.3	245.7	243.7	241.6	239.5	238.4	226.9	214.3	
3400	281.1	257.4	255.6	253.2	252.6	250.5	248.4	246.2	245.1	233.4	220.5	
3600	288.2	264.1	262.2	259.8	259.2	257.1	254.9	252.7	251.5	239.6	226.4	
3800	295.0	270.5	268.6	266.0	265.4	263.3	261.1	258.8	257.7	245.5	232.1	
4000	301.5	276.5	274.6	272.0	271.4	269.2	267.0	264.7	263.5	251.2	237.5	
4200	307.7	282.4	280.4	277.8	277.2	275.0	272.7	270.3	269.1	256.6	242.7	
4400	313.7	287.9	285.9	283.3	282.7	280.4	278.1	275.7	274.5	261.8	247.7	
4600	317.5	293.3	291.2	288.5	287.9	285.6	283.3	280.9	279.6	266.7	252.4	
4800	317.5	298.3	296.3	293.6	292.9	290.6	288.2	285.8	284.5	271.4	256.9	
CLIMB LIMIT WT (1000 KG)	242.2	241.4	240.8	238.8	238.3	235.6	232.7	229.7	228.2	212.1	195.7	

With engine bleed for packs off, increase field limit weight by 280 kg and climb limit weight by 800 kg.

With engine anti-ice on, decrease field limit weight by 30 kg.

With engine and wing anti-ice on, decrease field limit weight by 750 kg and climb limit weight by 1250 kg.

Takeoff Field & Climb Limit Weights

Flaps 15

8000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	°C	-40	14	18	22	23	25	27	29	30	40	50
	°F	-40	57	64	72	73	77	81	84	86	104	122
1470	171.7	155.5	153.4	151.4	150.9	149.7	148.2	146.6	145.8	137.2	128.4	
1600	180.2	163.4	161.2	159.1	158.6	157.4	155.9	154.2	153.3	144.4	135.2	
1800	192.2	174.6	172.3	170.1	169.6	168.3	166.7	164.9	164.0	154.7	145.1	
2000	203.3	185.0	182.6	180.3	179.8	178.5	176.8	174.9	174.0	164.3	154.4	
2200	213.7	194.7	192.2	189.9	189.3	188.0	186.3	184.3	183.4	173.3	163.0	
2400	223.5	203.9	201.3	198.9	198.3	196.9	195.1	193.1	192.2	181.8	171.1	
2600	232.8	212.6	210.0	207.5	206.9	205.4	203.6	201.5	200.5	189.8	178.8	
2800	241.8	220.9	218.2	215.6	215.0	213.5	211.6	209.5	208.4	197.4	186.1	
3000	249.6	228.2	225.4	222.7	222.1	220.5	218.6	216.4	215.3	203.9	192.3	
3200	257.1	235.1	232.2	229.5	228.9	227.3	225.3	223.1	221.9	210.3	198.4	
3400	264.2	241.8	238.8	236.0	235.4	233.8	231.7	229.5	228.3	216.4	204.2	
3600	271.0	248.1	245.1	242.3	241.6	240.0	237.9	235.6	234.4	222.3	209.9	
3800	277.5	254.2	251.1	248.3	247.6	245.9	243.8	241.4	240.2	227.9	215.2	
4000	283.7	260.0	256.9	254.0	253.3	251.6	249.4	247.0	245.8	233.2	220.4	
4200	289.6	265.6	262.4	259.4	258.7	257.0	254.8	252.3	251.1	238.4	225.3	
4400	295.3	270.9	267.7	264.6	263.9	262.2	260.0	257.5	256.2	243.3	230.0	
4600	300.8	276.0	272.7	269.6	268.9	267.2	264.9	262.4	261.1	248.0	234.5	
4800	305.9	280.8	277.5	274.4	273.7	271.9	269.6	267.0	265.7	252.4	238.8	
CLIMB LIMIT WT (1000 KG)	227.3	226.1	223.2	220.5	219.8	217.8	215.0	212.2	210.8	196.0	180.9	

With engine bleed for packs off, increase field limit weight by 280 kg and climb limit weight by 800 kg.

With engine anti-ice on, decrease field limit weight by 30 kg.

With engine and wing anti-ice on, decrease field limit weight by 750 kg and climb limit weight by 1250 kg.

Takeoff Obstacle Limit Weight**Flaps 15****Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off****Sea Level, 29°C & Below, Zero Wind**

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	254.2	275.9	292.8	303.4							
20	235.1	254.1	269.9	283.1	293.4	300.1	305.5	310.0			
40	216.9	234.7	249.7	262.7	273.7	282.8	290.1	295.4	299.6	303.2	306.3
60	202.3	220.3	235.5	248.3	259.0	268.1	276.0	282.6	288.3	292.7	296.2
80	190.4	208.9	224.0	236.6	247.3	256.4	264.2	271.1	277.2	282.4	286.9
100	180.1	198.9	214.1	226.6	237.2	246.4	254.4	261.3	267.5	273.0	277.9
120	170.1	190.2	205.2	217.8	228.5	237.7	245.8	252.8	259.1	264.6	269.7
140	168.4	182.3	197.2	209.8	220.6	229.9	238.0	245.2	251.6	257.2	262.3
160	161.3	174.7	190.0	202.6	213.4	222.7	231.0	238.2	244.7	250.5	255.7
180	154.8	167.3	183.5	195.9	206.7	216.2	224.5	231.8	238.4	244.2	249.5
200		166.4	177.2	189.8	200.6	210.1	218.4	225.8	232.5	238.4	243.8
220		160.7	171.4	184.2	194.9	204.4	212.8	220.2	226.9	233.0	238.5
240		155.5	165.4	178.9	189.6	199.0	207.4	215.0	221.7	227.9	233.4
260			164.9	173.9	184.6	194.0	202.4	210.0	216.8	223.0	228.6
280			160.3	168.7	180.1	189.3	197.7	205.3	212.2	218.4	224.0
300			155.9	166.5	175.7	184.9	193.3	200.8	207.7	214.0	219.7

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.**OAT Adjustment**

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
29 & BELOW	0	0	0	0	0	0	0	0
30	-1.0	-1.2	-1.3	-1.4	-1.6	-1.7	-1.8	-2.0
32	-3.1	-3.5	-3.9	-4.3	-4.7	-5.1	-5.5	-5.9
34	-5.1	-5.8	-6.5	-7.2	-7.9	-8.5	-9.2	-9.9
36	-7.2	-8.1	-9.1	-10.0	-11.0	-11.9	-12.9	-13.9
38	-9.2	-10.5	-11.7	-12.9	-14.1	-15.4	-16.6	-17.8
40	-11.3	-12.8	-14.3	-15.8	-17.3	-18.8	-20.3	-21.8
42	-14.3	-16.3	-18.3	-20.2	-22.2	-24.2	-26.2	-28.1
44	-17.3	-19.8	-22.2	-24.7	-27.2	-29.6	-32.1	-34.5
46	-20.3	-23.3	-26.2	-29.2	-32.1	-35.0	-38.0	-40.9
48	-23.4	-26.8	-30.2	-33.6	-37.0	-40.4	-43.9	-47.3
50	-26.4	-30.3	-34.2	-38.1	-42.0	-45.9	-49.8	-53.6

Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
S.L. & BELOW	0	0	0	0	0	0	0	0
1000	-6.0	-6.7	-7.3	-8.0	-8.7	-9.3	-10.0	-10.7
2000	-12.7	-14.1	-15.6	-17.0	-18.5	-19.9	-21.4	-22.8
3000	-19.4	-21.7	-24.0	-26.3	-28.6	-30.9	-33.1	-35.4

Takeoff Obstacle Limit Weight

Flaps 15

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

Wind Adjustment

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
15 TW	-20.1	-20.7	-21.2	-21.8	-22.4	-22.9	-23.5	-24.1
10 TW	-13.4	-13.8	-14.2	-14.5	-14.9	-15.3	-15.7	-16.1
5 TW	-6.7	-6.9	-7.1	-7.3	-7.5	-7.6	-7.8	-8.0
0	0	0	0	0	0	0	0	0
10 HW	4.5	4.1	3.7	3.2	2.8	2.4	2.0	1.6
20 HW	9.0	8.2	7.3	6.5	5.7	4.8	4.0	3.2
30 HW	12.5	11.4	10.3	9.2	8.2	7.1	6.0	4.9
40 HW	16.0	14.7	13.3	12.0	10.7	9.3	8.0	6.7

With engine bleed for packs off, increase weight by 300 kg.

With engine and wing anti-ice on, decrease weight by 1400 kg.

Brake Energy Limits VMBE**Maximum Brake Energy Speed**

OAT (°C)	REFERENCE VMBE (KIAS)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
54	198	190				
50	198	191	184			
46	199	191	185	178		
42	200	192	185	179	172	
38	200	193	186	180	173	167
34	202	194	187	180	174	168
30	203	194	188	181	175	169
26	205	196	189	182	176	170
22	207	198	190	184	177	171
18	208	199	192	185	178	172
14	210	201	194	186	180	173
10	210	203	195	188	181	174
6	210	205	197	190	183	176
2	210	207	199	191	184	177
-2	210	209	201	193	186	179
-6	210	210	202	195	188	180
-10	210	210	204	197	189	182

Weight Adjusted VMBE

WEIGHT (1000 KG)	REFERENCE VMBE (KIAS)										
	160	165	170	175	180	185	190	195	200	205	210
160	205	210	210	210	210	210	210	210	210	210	210
170	196	202	209	210	210	210	210	210	210	210	210
180	188	194	201	207	210	210	210	210	210	210	210
190	182	188	194	200	206	210	210	210	210	210	210
200	177	183	188	194	200	206	210	210	210	210	210
210	172	178	183	189	194	200	205	210	210	210	210
220	168	173	178	184	189	195	200	205	210	210	210
230	164	169	174	179	184	190	195	200	205	210	210
240	160	165	170	175	180	185	190	195	200	205	210
250	156	161	166	171	176	181	185	190	195	200	205
260	153	158	162	167	172	177	181	186	191	195	200
270	150	155	159	164	168	173	177	182	187	191	196
280	147	152	156	161	165	169	174	178	183	187	192
290	145	149	153	158	162	166	171	175	179	183	188
300	142	147	151	155	159	163	167	172	176	180	184
310	140	144	148	152	156	161	165	169	173	177	181

Increase VMBE by 3 knots per 1% uphill runway slope. Decrease VMBE by 5 knots per 1% downhill runway slope.

Increase VMBE by 5 knots per 10 knots headwind. Decrease VMBE by 21 knots per 10 knots tailwind.

Decrease VMBE by 10 knots for one brake deactivated and 20 knots for two brakes deactivated.

Decrease brake release weight by 1600 kg for each knot V1 exceeds VMBE.

Determine normal V1, VR, V2 speeds for lower brake release weight.

Takeoff Speeds

Flaps 15

V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	FLAPS 15		
	V1	VR	V2
300	157	162	168
290	153	159	165
280	150	156	163
270	147	153	160
260	144	150	157
250	140	146	154
240	137	143	152
230	133	139	149
220	129	136	146
210	126	132	143
200	121	129	140
190	117	125	136
180	112	121	133
170	107	117	130
160	103	113	126
150	98	108	123
140	93	104	119

Check V1(MCG) and Minimum VR.

V1, VR, V2 Adjustments*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
°C	°F	-2	0	2	4	6	8	-2	0	2	4	6	8	-2	0	2	4	6	8
60	140	7	8	10	12	3	4	5	6	-2	-2	-3	-3	-1	-1	-2	-2	-3	-3
50	122	4	5	7	9	11	13	2	2	3	4	5	6	0	-1	-1	-2	-2	-3
40	104	1	2	4	7	8	10	1	1	2	3	4	5	0	-1	-1	-2	-2	-3
30	86	0	0	2	5	7	9	0	0	1	2	4	5	0	0	-1	-1	-2	-2
20	68	0	0	1	3	6	7	0	0	1	2	3	4	0	0	0	-1	-1	-2
-60	-76	0	0	1	3	5	7	0	0	1	2	3	4	0	0	0	-1	-1	-2

Slope and Wind V1 Adjustments*

WEIGHT (1000 KG)	SLOPE (%)						WIND (KTS)							
	-2	-1	0	1	2		-15	-10	-5	0	10	20	30	40
300	-5	-2	0	2	4		-2	-1	-1	0	0	1	1	2
280	-4	-2	0	2	4		-2	-1	0	0	0	1	1	2
260	-4	-2	0	2	3		-2	-1	0	0	0	1	1	2
240	-3	-1	0	2	3		-2	-1	0	0	0	1	1	2
220	-3	-1	0	2	3		-2	-1	0	0	0	1	1	2
200	-3	-1	0	2	3		-2	-1	0	0	0	1	1	2
180	-3	-1	0	2	3		-2	-1	0	0	1	1	2	2
160	-3	-1	0	2	3		-2	-1	0	0	1	1	2	2
140	-3	-1	0	2	3		-2	-1	0	0	1	1	2	2

*V1 not to exceed VR

Takeoff Speeds
Flaps 15
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		-2000		0		2000		4000		6000		8000	
°C	°F	V1 (MCG)	MinVR	V1 (MCG)	MinVR	V1 (MCG)	MinVR	V1 (MCG)	MinVR	V1 (MCG)	MinVR	V1 (MCG)	MinVR
60	140	113	114	109	111	108	109	106	108				
50	122	115	116	112	114	108	110	106	108	104	106	101	104
40	104	121	122	118	119	114	115	109	110	105	107	101	104
30	86	123	124	122	123	118	119	113	114	108	110	104	106
20	68	123	124	123	123	119	120	115	117	111	113	107	109
-60	-76	124	124	124	124	120	121	116	117	112	113	109	110

Intentionally
Blank

Performance Dispatch**Chapter PD****Enroute****Section 21****Long Range Cruise Maximum Operating Altitude****Max Climb Thrust****ISA + 10°C and Below**

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	-1	33500*	33500*	33500*	33400	31900
290	31100	-3	34300*	34300*	34300*	34100	32700
280	31800	-5	35200*	35200*	35200*	34900	33400
270	32600	-7	36100*	36100*	36100*	35600	34200
260	33400	-8	36800*	36800*	36800*	36400	35000
250	34200	-10	37600*	37600*	37600*	37200	35800
240	35100	-12	38400*	38400*	38400*	38100	36600
230	36000	-14	39300*	39300*	39300*	39000	37500
220	36900	-14	40200*	40200*	40200*	39900	38500
210	37900	-14	41100*	41100*	41100*	40900	39400
200	38900	-14	42100*	42100*	42100*	41900	40400
190	40000	-14	43000	43000	43000	42900	41500
180	41100	-14	43000	43000	43000	43000	42600
170	42300	-14	43000	43000	43000	43000	43000
160	43000	-14	43000	43000	43000	43000	43000
150	43000	-14	43000	43000	43000	43000	43000
140	43000	-14	43000	43000	43000	43000	43000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	4	32500*	32500*	32500*	32500*	31900
290	31100	3	33400*	33400*	33400*	33400*	32700
280	31800	1	34300*	34300*	34300*	34300*	33400
270	32600	-1	35200*	35200*	35200*	35200*	34200
260	33400	-3	36100*	36100*	36100*	36100*	35000
250	34200	-5	36900*	36900*	36900*	36900*	35800
240	35100	-7	37700*	37700*	37700*	37700*	36600
230	36000	-9	38600*	38600*	38600*	38600*	37500
220	36900	-9	39500*	39500*	39500*	39500*	38500
210	37900	-9	40400*	40400*	40400*	40400*	39400
200	38900	-9	41400*	41400*	41400*	41400*	40400
190	40000	-9	42400*	42400*	42400*	42400*	41500
180	41100	-9	43000	43000	43000	43000	42600
170	42300	-9	43000	43000	43000	43000	43000
160	43000	-9	43000	43000	43000	43000	43000
150	43000	-9	43000	43000	43000	43000	43000
140	43000	-9	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	10	31100*	31100*	31100*	31100*	31100*
290	31100	8	32100*	32100*	32100*	32100*	32100*
280	31800	7	33100*	33100*	33100*	33100*	33100*
270	32600	5	34100*	34100*	34100*	34100*	34100*
260	33400	3	35100*	35100*	35100*	35100*	35000
250	34200	1	36100*	36100*	36100*	36100*	35800
240	35100	-1	36800*	36800*	36800*	36800*	36600
230	36000	-3	37700*	37700*	37700*	37700*	37500
220	36900	-3	38600*	38600*	38600*	38600*	38500
210	37900	-3	39500*	39500*	39500*	39500*	39400
200	38900	-3	40500*	40500*	40500*	40500*	40400
190	40000	-3	41500*	41500*	41500*	41500*	41500
180	41100	-3	42600*	42600*	42600*	42600*	42600
170	42300	-3	43000	43000	43000	43000	43000
160	43000	-3	43000	43000	43000	43000	43000
150	43000	-3	43000	43000	43000	43000	43000
140	43000	-3	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1051	990	934	885	840	800	767	736	707	680	656
1571	1480	1398	1325	1260	1200	1151	1105	1062	1023	987
2089	1971	1863	1766	1680	1600	1535	1474	1417	1366	1318
2606	2459	2325	2206	2099	2000	1919	1843	1773	1708	1649
3121	2946	2787	2645	2517	2400	2303	2213	2129	2051	1980
3635	3433	3248	3084	2936	2800	2688	2583	2485	2394	2311
4147	3918	3709	3523	3355	3200	3072	2952	2840	2737	2643
4657	4402	4169	3961	3773	3600	3456	3321	3196	3080	2974
5166	4885	4628	4398	4191	4000	3839	3690	3551	3423	3305
5674	5367	5086	4836	4609	4400	4224	4059	3907	3766	3636
6181	5849	5545	5273	5027	4800	4608	4429	4262	4108	3967
6686	6329	6002	5709	5444	5200	4992	4798	4617	4451	4298
7190	6809	6459	6146	5862	5600	5376	5167	4973	4794	4629
7693	7288	6915	6582	6279	6000	5761	5537	5329	5137	4960
8196	7766	7371	7017	6696	6400	6145	5906	5684	5479	5291
8698	8244	7827	7453	7113	6800	6528	6275	6039	5822	5622
9200	8721	8282	7888	7530	7200	6913	6644	6395	6164	5953
9702	9199	8738	8323	7947	7600	7297	7014	6751	6508	6285
10204	9677	9194	8759	8365	8000	7681	7383	7106	6850	6615

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37	
	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME
	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)
800	12.4	2:00	12.1	1:58	11.9	1:56	11.7	1:54	11.5	1:52
1200	17.9	2:56	17.4	2:52	17.1	2:49	16.8	2:45	16.5	2:42
1600	23.6	3:51	23.0	3:46	22.5	3:41	22.0	3:36	21.6	3:32
2000	29.4	4:45	28.6	4:39	27.9	4:32	27.3	4:27	26.8	4:22
2400	35.2	5:39	34.2	5:31	33.4	5:24	32.7	5:17	32.1	5:12
2800	41.3	6:32	40.1	6:23	39.1	6:14	38.2	6:07	37.5	6:02
3200	47.4	7:24	46.0	7:14	44.9	7:05	43.8	6:57	43.1	6:52
3600	53.5	8:17	52.0	8:05	50.7	7:55	49.5	7:47	48.7	7:42
4000	59.9	9:08	58.2	8:56	56.7	8:44	55.4	8:36	54.6	8:32
4400	66.3	9:59	64.4	9:46	62.8	9:34	61.4	9:26	60.6	9:22
4800	72.9	10:50	70.8	10:36	68.9	10:23	67.5	10:16	66.8	10:12
5200	79.6	11:40	77.3	11:25	75.3	11:13	73.8	11:05	73.3	11:02
5600	86.4	12:29	83.9	12:14	81.8	12:02	80.3	11:55		
6000	93.3	13:19	90.6	13:03	88.5	12:51	86.9	12:45		
6400	100.4	14:08	97.6	13:52	95.3	13:40	93.8	13:35		
6800	107.6	14:57	104.6	14:41	102.3	14:30	101.0	14:25		
7200	114.9	15:46	111.8	15:30	109.5	15:19	108.4	15:15		
7600	122.4	16:35	119.3	16:19	116.9	16:09				
8000	130.1	17:23	126.8	17:08	124.6	16:58				

**Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	140	160	180	200	220
10	-1.2	-0.6	0.0	0.8	1.6
20	-2.4	-1.1	0.0	1.7	3.6
30	-3.6	-1.8	0.0	2.7	6.0
40	-4.8	-2.4	0.0	3.8	8.7
50	-6.0	-3.0	0.0	5.0	11.7
60	-7.3	-3.7	0.0	6.4	15.0
70	-8.6	-4.3	0.0	7.9	18.7
80	-9.9	-5.0	0.0	9.6	22.8
90	-11.2	-5.7	0.0	11.3	27.1
100	-12.6	-6.4	0.0	13.2	31.9
110	-14.0	-7.1	0.0	15.2	36.9
120	-15.4	-7.8	0.0	17.4	42.3
130	-16.9	-8.6	0.0	19.7	48.0
140	-18.3	-9.3	0.0	22.1	54.1

Based on 310/.84 climb, Long Range Cruise and .84/310/250 descent.

Long Range Cruise Step Climb
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1040	981	928	881	839	800	765	732	703	675	650
1545	1461	1386	1318	1256	1200	1149	1102	1058	1018	981
2050	1941	1843	1754	1673	1600	1533	1471	1414	1361	1312
2555	2421	2300	2190	2091	2000	1917	1840	1769	1704	1643
3060	2900	2757	2627	2508	2400	2301	2209	2125	2047	1974
3564	3380	3214	3063	2925	2800	2685	2579	2481	2390	2306
4069	3859	3670	3499	3343	3200	3069	2948	2837	2733	2637
4573	4339	4127	3935	3760	3600	3453	3318	3192	3076	2968
5078	4818	4584	4371	4177	4000	3837	3687	3548	3419	3300
5582	5297	5040	4807	4595	4400	4221	4056	3904	3763	3631
6086	5776	5497	5243	5012	4800	4605	4426	4260	4106	3963
6590	6256	5953	5679	5429	5200	4990	4795	4616	4449	4294
7094	6735	6410	6115	5846	5600	5374	5165	4972	4792	4626
7598	7214	6867	6551	6264	6000	5758	5534	5328	5136	4957
8103	7693	7323	6987	6681	6400	6142	5904	5683	5479	5289
8607	8173	7780	7423	7098	6800	6526	6273	6039	5822	5620
9111	8652	8237	7859	7515	7200	6910	6643	6395	6165	5952
9616	9131	8693	8296	7933	7600	7294	7012	6751	6508	6283
10121	9611	9150	8732	8350	8000	7678	7381	7107	6852	6614

Trip Fuel and Time Required

AIR DIST (NM)	TRIP FUEL (1000 KG)									TIME (HRS:MIN)
	LANDING WEIGHT (1000 KG)									
	140	150	160	170	180	190	200	210	220	
800	9.6	10.1	10.4	11.0	11.5	11.9	12.4	13.0	13.5	1:51
1200	13.6	14.2	14.9	15.7	16.4	17.1	17.9	18.7	19.4	2:41
1600	17.7	18.5	19.5	20.5	21.4	22.4	23.5	24.6	25.4	3:31
2000	21.9	22.9	24.2	25.5	26.6	27.9	29.3	30.6	31.7	4:21
2400	26.1	27.5	28.9	30.5	31.9	33.5	35.1	36.7	38.1	5:11
2800	30.5	32.1	33.8	35.6	37.4	39.2	41.1	42.9	44.7	6:00
3200	35.0	36.8	38.8	40.9	43.0	45.1	47.2	49.4	51.5	6:50
3600	39.5	41.7	43.9	46.4	48.7	51.1	53.5	56.0	58.4	7:40
4000	44.2	46.6	49.2	51.9	54.5	57.2	60.0	62.8	65.5	8:29
4400	49.0	51.7	54.6	57.6	60.5	63.5	66.6	69.8	72.7	9:19
4800	53.9	56.8	60.1	63.5	66.6	70.0	73.5	76.9	80.2	10:09
5200	58.9	62.2	65.7	69.4	72.9	76.6	80.4	84.2	87.8	10:58
5600	64.0	67.7	71.5	75.5	79.3	83.4	87.6	91.6	95.7	11:48
6000	69.2	73.3	77.4	81.7	85.9	90.4	94.9	99.3	103.7	12:37
6400	74.6	79.0	83.4	88.1	92.7	97.5	102.4	107.2		13:27
6800	80.2	84.8	89.6	94.7	99.7	104.8	110.1	115.4		14:17
7200	85.8	90.8	96.0	101.5	106.8	112.3				15:06
7600	91.6	96.9	102.5	108.4	114.1	120.0				15:56
8000	97.5	103.2	109.3	115.5	121.6	127.9				16:46

Based on 310/.84 climb, LRC and .84/310/250 descent.
Valid for all pressure altitudes with 4000 ft step climb to 2000 ft above optimum altitude.

Short Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
93	79	69	61	55	50	46	42	39	36	34
159	142	129	117	108	100	93	87	82	77	73
224	204	187	173	161	150	141	133	125	119	113
287	264	245	228	213	200	189	178	169	161	153
349	324	301	282	265	250	237	224	214	204	195
411	382	358	336	317	300	285	271	258	247	236
472	441	414	390	369	350	333	317	303	290	278
534	500	471	445	421	400	381	364	348	333	320
597	560	528	499	473	450	429	410	392	376	361
661	621	586	554	526	500	477	456	436	418	402

Trip Fuel and Time Required

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		140	160	180	200	220	
50	FUEL (1000 KG)	1.5	1.6	1.7	1.8	1.9	0:14
	ALT (FT)	10000	10000	9000	8000	8000	
100	FUEL (1000 KG)	2.3	2.4	2.6	2.7	2.9	0:22
	ALT (FT)	19000	18000	17000	16000	15000	
150	FUEL (1000 KG)	3.0	3.2	3.4	3.6	3.8	0:30
	ALT (FT)	27000	25000	24000	22000	21000	
200	FUEL (1000 KG)	3.6	3.9	4.1	4.4	4.6	0:36
	ALT (FT)	34000	31000	29000	28000	26000	
250	FUEL (1000 KG)	4.2	4.5	4.8	5.1	5.4	0:43
	ALT (FT)	39000	36000	34000	32000	30000	
300	FUEL (1000 KG)	4.7	5.0	5.4	5.8	6.2	0:48
	ALT (FT)	43000	40000	37000	35000	33000	
350	FUEL (1000 KG)	5.1	5.6	6.0	6.5	6.9	0:54
	ALT (FT)	43000	42000	39000	36000	34000	
400	FUEL (1000 KG)	5.6	6.1	6.6	7.1	7.6	1:00
	ALT (FT)	43000	42000	39000	36000	34000	
450	FUEL (1000 KG)	6.1	6.6	7.2	7.8	8.3	1:06
	ALT (FT)	43000	42000	39000	36000	34000	
500	FUEL (1000 KG)	6.6	7.2	7.8	8.4	9.1	1:13
	ALT (FT)	43000	42000	39000	36000	34000	

Holding Planning
Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)									
	PRESSURE ALTITUDE (FT)									
	1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
300	8700	8640	8370	8470	8880	9070	9420			
280	8110	8030	7780	7780	8110	8350	8600	9090		
260	7540	7450	7370	7150	7470	7650	7850	8110		
240	7120	7020	6920	6700	6750	6970	7120	7410		
220	6560	6460	6340	6280	6100	6330	6430	6620	7170	
200	6020	5920	5780	5700	5520	5600	5750	5900	6260	
180	5640	5390	5260	5160	5100	4940	5150	5210	5530	5750
160	5130	5020	4760	4650	4580	4520	4430	4640	4880	5110
140	4660	4530	4390	4160	4070	4010	3880	3950	4190	4340

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
300	9360	9070	9040	9070	9130
280	8700	8630	8370	8390	8430
260	8070	7980	7710	7710	7870
240	7440	7350	7260	7180	7190
220	6970	6880	6760	6540	6540
200	6360	6270	6160	6070	5900
180	5910	5680	5570	5470	5290
160	5340	5230	5000	4900	4820
140	4800	4670	4550	4340	4250

These tables include 5% additional fuel for holding in a racetrack pattern.

Crew Oxygen Requirements

Required Pressure (PSI) for One 114/115 Cubic Ft. Cylinder

BOTTLE TEMPERATURE		NUMBER OF CREW USING OXYGEN		
°C	°F	2	3	4
50	122	530	735	945
45	113	520	725	930
40	104	510	715	915
35	95	505	700	900
30	86	495	690	885
25	77	485	680	870
20	68	480	670	860
15	59	470	655	840
10	50	460	645	830
5	41	455	635	815
0	32	445	620	800
-5	23	440	610	785
-10	14	430	600	770

For more extensive than normal crew usage, add 1.2 psi/person/minute.

ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
29	151.8		
28	159.5	151.6	
27	167.5	159.5	151.3
26	175.8	167.6	159.2
25	184.4	176.1	167.4
24	192.4	183.7	174.7
23	200.6	191.7	182.1
22	209.1	199.9	189.8
21	218.0	208.4	197.8
20	227.1	217.2	206.1
19	236.0	225.9	214.5
18	245.2	234.8	223.2
17	254.6	244.0	232.1
16	264.3	253.5	241.4
15	272.4	261.5	248.8
14	280.8	269.5	256.4
13	289.2	277.7	264.2
12	297.8	285.8	272.1
11	305.6	292.9	278.6
10	313.5	300.0	284.7
9		306.8	290.2
8		313.4	295.8
7			301.3
6			306.6
5			311.8
4			316.2

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG)								
	PRESSURE ALTITUDE (1000 FT)								
	10	12	14	16	18	20	22	24	26
ENGINE ONLY	-4.3	-3.8	-3.3	-2.7	-1.9	-1.1	-1.4	-1.2	-0.9
ENGINE AND WING	-5.7	-5.2	-4.7	-4.2	-3.4	-2.6	-3.2	-3.0	-2.8

ALL ENGINES**Decompression Critical Fuel Reserves - LRC Cruise
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEAD WIND COMPONENT (KTS)						TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
282	260	242	226	212	200	189	179	170	162	155
566	523	485	453	425	400	378	358	340	324	309
850	785	729	680	638	600	567	537	510	486	464
1134	1047	972	907	850	800	755	716	680	647	618
1418	1309	1215	1134	1063	1000	944	894	850	809	772
1703	1571	1458	1361	1275	1200	1133	1073	1019	971	927
1987	1833	1702	1588	1488	1400	1322	1252	1189	1132	1081
2271	2095	1945	1814	1700	1600	1511	1431	1359	1294	1235
2555	2357	2188	2041	1913	1800	1700	1610	1529	1456	1389
2839	2619	2431	2268	2126	2000	1888	1789	1699	1617	1544
3124	2882	2674	2495	2338	2200	2077	1967	1869	1779	1698
3408	3144	2918	2722	2551	2400	2266	2146	2038	1941	1852
3692	3406	3161	2949	2763	2600	2455	2325	2208	2103	2007
3976	3668	3404	3176	2976	2800	2644	2504	2378	2264	2161
4260	3930	3647	3403	3189	3000	2832	2683	2548	2426	2315

Critical Fuel (1000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)							
	160	180	200	220	240	260	280	300
200	4.4	4.6	4.8	5.1	5.3	5.4	5.6	5.9
400	8.1	8.5	8.8	9.2	9.5	9.8	10.1	10.5
600	11.7	12.3	12.8	13.4	13.8	14.1	14.6	15.2
800	15.2	16.0	16.6	17.4	18.0	18.5	19.1	19.8
1000	18.8	19.7	20.5	21.4	22.2	22.8	23.5	24.4
1200	22.4	23.4	24.3	25.4	26.3	27.0	27.8	28.8
1400	25.9	27.1	28.2	29.4	30.5	31.3	32.2	33.3
1600	29.5	30.7	32.0	33.3	34.6	35.6	36.6	37.8
1800	33.0	34.3	35.7	37.2	38.6	39.7	40.8	42.2
2000	36.6	37.8	39.4	41.0	42.6	43.9	45.1	46.6
2200	40.1	41.4	43.1	44.9	46.6	48.0	49.4	51.0
2400	43.7	44.9	46.9	48.7	50.6	52.2	53.7	55.3
2600	47.2	48.5	50.5	52.5	54.5	56.2	57.9	59.6
2800	50.8	52.1	54.0	56.2	58.3	60.2	62.0	63.9
3000	54.3	55.6	57.6	59.9	62.2	64.2	66.2	68.2

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included.

Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required 0.8% per 10°C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (4%) for the total forecast time or engine and wing anti-ice on and ice drag (8%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engine cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

ENGINE INOP

**Decompression Critical Fuel Reserves - LRC Cruise
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEAD WIND COMPONENT (KTS)						TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
283	262	243	227	212	200	189	179	170	162	155
572	527	488	455	426	400	377	357	339	322	307
861	792	734	683	639	600	566	535	508	483	460
1150	1058	979	911	852	800	754	713	676	643	613
1439	1323	1224	1139	1065	1000	942	891	845	804	766
1729	1589	1470	1367	1278	1200	1131	1069	1014	964	919
2018	1854	1715	1595	1491	1400	1319	1247	1183	1125	1072
2307	2119	1960	1823	1704	1600	1508	1425	1352	1285	1225
2596	2385	2206	2052	1918	1800	1696	1603	1520	1446	1378
2885	2650	2451	2280	2131	2000	1884	1781	1689	1606	1531
3174	2916	2696	2508	2344	2200	2073	1960	1858	1766	1683
3463	3181	2942	2736	2557	2400	2261	2138	2027	1927	1836
3752	3447	3187	2964	2770	2600	2450	2316	2196	2087	1989
4041	3712	3432	3192	2983	2800	2638	2494	2364	2248	2142
4330	3977	3678	3420	3196	3000	2826	2672	2533	2408	2295

Critical Fuel (1000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)							
	160	180	200	220	240	260	280	300
200	4.0	4.3	4.5	4.8	5.0	5.3	5.6	5.8
400	7.4	7.9	8.3	8.7	9.2	9.6	10.1	10.5
600	10.6	11.3	12.0	12.7	13.3	14.0	14.6	15.3
800	13.8	14.7	15.6	16.5	17.4	18.3	19.2	20.0
1000	16.9	18.1	19.2	20.3	21.4	22.5	23.5	24.6
1200	20.1	21.5	22.8	24.1	25.3	26.6	27.9	29.1
1400	23.3	24.8	26.4	27.8	29.3	30.8	32.3	33.7
1600	26.5	28.2	29.9	31.6	33.3	35.0	36.6	38.2
1800	29.6	31.3	33.3	35.2	37.1	39.0	40.8	42.6
2000	32.8	34.5	36.7	38.8	40.8	42.9	45.0	47.0
2200	36.0	37.7	40.1	42.4	44.6	46.9	49.1	51.3
2400	39.2	40.9	43.4	45.9	48.4	50.9	53.3	55.7
2600	42.3	44.0	46.8	49.5	52.1	54.8	57.4	59.9
2800	45.5	47.2	50.0	52.9	55.7	58.5	61.3	64.1
3000	48.7	50.4	53.2	56.3	59.3	62.3	65.3	68.2

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

- Adjustments:
- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
 - Increase fuel required 0.8% per 10°C above ISA.
 - When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (8%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

ENGINE INOP**Driftdown Critical Fuel Reserves - LRC Driftdown/Cruise
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
264	248	234	221	210	200	190	182	174	167	160
530	498	469	443	420	400	381	364	348	334	320
799	749	705	666	631	600	571	545	521	500	480
1069	1002	942	889	842	800	761	726	694	665	638
1342	1256	1180	1113	1053	1000	951	907	867	830	796
1615	1511	1419	1337	1265	1200	1141	1087	1039	995	954
1890	1767	1658	1562	1476	1400	1330	1268	1211	1159	1111
2167	2023	1898	1787	1688	1600	1520	1448	1382	1323	1268
2444	2280	2138	2012	1900	1800	1709	1628	1554	1486	1424
2721	2538	2378	2237	2112	2000	1899	1808	1725	1649	1580
2999	2796	2618	2462	2323	2200	2088	1988	1896	1813	1736
3277	3054	2859	2687	2535	2400	2277	2167	2067	1976	1893
3555	3312	3099	2913	2747	2600	2467	2347	2238	2139	2049
3833	3569	3340	3138	2959	2800	2656	2527	2410	2303	2205
4110	3827	3580	3363	3171	3000	2846	2707	2581	2466	2361

Critical Fuel (1000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)							
	160	180	200	220	240	260	280	300
200	4.2	4.4	4.6	4.9	5.1	5.3	5.6	5.7
400	6.8	7.3	7.8	8.3	8.8	9.4	9.9	10.3
600	9.2	10.0	10.8	11.6	12.4	13.3	14.1	14.8
800	11.6	12.7	13.8	14.9	16.0	17.1	18.3	19.2
1000	14.0	15.3	16.7	18.1	19.5	20.9	22.4	23.6
1200	16.3	18.0	19.6	21.3	23.0	24.7	26.4	28.0
1400	18.6	20.5	22.5	24.4	26.4	28.4	30.5	32.2
1600	20.9	23.1	25.3	27.6	29.8	32.1	34.4	36.5
1800	23.2	25.6	28.1	30.7	33.2	35.7	38.4	40.7
2000	25.4	28.2	30.9	33.7	36.5	39.3	42.2	44.8
2200	27.6	30.6	33.7	36.7	39.8	42.9	46.1	48.9
2400	29.8	33.1	36.4	39.7	43.0	46.4	49.9	52.9
2600	32.0	35.5	39.1	42.7	46.3	49.9	53.6	57.0
2800	34.1	37.9	41.7	45.6	49.4	53.3	57.3	60.9
3000	36.2	40.3	44.4	48.5	52.6	56.7	61.0	64.8

Based on: Driftdown to and cruise at level off altitude, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required 0.8% per 10°C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (10%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

Intentionally
Blank

Performance Dispatch**Chapter PD****Landing****Section 22****Landing Field Limit Weight - Dry Runway****Flaps 30****Wind Adjusted Field Length (M)**

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1200				1200	1250	1350	1410	1500
1400		1130	1250	1400	1460	1560	1630	1730
1600	1200	1310	1440	1600	1670	1770	1860	1960
1800	1370	1490	1630	1800	1880	1980	2080	2190
2000	1540	1670	1830	2000	2090	2190	2300	2420
2200	1710	1860	2020	2200	2310	2400	2530	2650
2400	1880	2040	2210	2400	2520	2610	2750	2880
2600	2050	2220	2400	2600	2730	2820	2970	3110
2800	2220	2380	2580	2800	2940	3030	3190	3340
3000	2350	2530	2750	3000	3150	3240	3420	3570
3200	2480	2690	2930	3200	3360	3450	3640	3800
3400	2620	2840	3100	3400	3570	3660	3860	
3600	2750	3000	3280	3600	3780	3870		
3800	2880	3160	3450	3800				
4000	3010	3310	3620	4000				
4200	3140	3470	3800					
4400	3280	3620	3980					
4600	3410	3780	4150					
4800	3540	3940						
5000	3670	4090						

Field Limit Weight (1000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1200	144.2	135.7			
1400	177.2	166.9	156.9	147.3	138.2
1600	210.9	198.6	186.7	175.4	164.8
1800	234.8	226.6	217.2	204.1	191.8
2000	253.9	245.1	236.4	227.9	219.2
2200	272.1	262.8	253.5	244.5	235.7
2400	289.3	279.5	269.9	260.4	251.0
2600	305.4	295.4	285.4	275.5	265.8
2800	321.0	310.4	300.1	289.9	279.8
3000		322.9	311.6	301.3	291.2
3200			322.1	311.3	300.9
3400				320.8	309.9
3600					318.6
3800					327.4

With 1 brake deactivated, decrease weight by 16200 kg.

With 2 brakes deactivated, decrease weight by 32900 kg.

With manual speedbrakes, decrease weight by 17500 kg.

Landing Field Limit Weight - Wet Runway

Flaps 30

Wind Adjusted Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1200						1360	1420	1520
1400				1400	1460	1570	1640	1750
1600		1290	1430	1600	1670	1780	1870	1980
1800	1350	1470	1620	1800	1880	1990	2090	2210
2000	1520	1650	1810	2000	2090	2200	2310	2440
2200	1690	1830	2000	2200	2300	2410	2540	2670
2400	1860	2020	2190	2400	2510	2620	2760	2900
2600	2030	2200	2390	2600	2720	2830	2980	3130
2800	2200	2380	2580	2800	2940	3040	3200	3360
3000	2370	2560	2770	3000	3150	3250	3430	3590
3200	2540	2720	2940	3200	3360	3460	3650	3820
3400	2670	2870	3120	3400	3570	3670	3870	4050
3600	2800	3030	3290	3600	3780	3880	4100	4280
3800	2940	3180	3470	3800	3990	4090	4320	
4000	3070	3340	3640	4000	4200			
4200	3200	3500	3820	4200				
4400	3330	3650	3990	4400				
4600	3460	3810	4170	4600				
4800	3600	3960	4340					
5000	3730	4120	4520					

Field Limit Weight (1000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1400	147.1	138.4			
1600	175.8	165.5	155.6	146.1	137.0
1800	205.0	193.0	181.5	170.5	160.1
2000	228.7	219.3	207.9	195.4	183.5
2200	245.7	237.2	228.7	219.9	207.2
2400	262.0	252.9	244.0	235.2	226.7
2600	277.4	267.9	258.6	249.4	240.4
2800	292.1	282.3	272.6	263.0	253.6
3000	306.0	296.0	286.1	276.1	266.4
3200	319.6	309.1	298.8	288.7	278.6
3400		320.2	309.3	299.1	289.0
3600			318.5	307.8	297.6
3800				316.2	305.6
4000				324.5	313.3
4200					320.9

With 1 brake deactivated, decrease weight by 16200 kg.

With 2 brakes deactivated, decrease weight by 32900 kg.

With manual speedbrakes, decrease weight by 17500 kg.

Landing Climb Limit Weight**Valid for approach with flaps 20 and landing with flaps 25 or 30**

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
54	129	258.6	243.7				
52	126	264.6	249.6				
50	122	270.9	255.3	236.3			
48	118	277.2	261.0	242.0			
46	115	283.6	266.6	247.5	227.9		
44	111	289.9	272.9	253.0	232.3		
42	108	294.5	279.4	258.3	236.5	219.7	
40	104	298.9	285.7	263.4	240.9	223.4	
38	100	303.1	290.9	268.8	244.9	226.8	209.6
36	97	307.2	296.1	273.9	249.0	230.3	212.9
34	93	311.2	300.9	278.2	253.1	233.7	216.1
32	90	311.3	305.3	282.4	256.9	237.2	219.3
30	86	311.3	309.7	286.6	260.6	240.8	222.4
28	82	311.4	309.7	290.4	264.4	244.5	225.8
26	79	311.4	309.7	294.1	267.9	248.0	229.2
24	75	311.5	309.8	294.9	271.1	251.4	232.5
22	72	311.6	309.8	294.9	274.2	253.5	234.1
20	68	311.6	309.9	294.9	274.8	254.5	235.5
18	64	311.6	309.9	295.0	274.9	255.6	237.2
16	61	311.6	310.0	295.1	274.9	256.1	239.0
14	57	311.7	310.0	295.1	275.0	256.1	240.5
12	54	311.7	310.1	295.2	275.0	256.2	240.6
10	50	311.8	310.2	295.2	275.1	256.2	240.7
-40	-40	312.9	311.5	296.6	276.3	257.3	241.7

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.**With engine bleed for packs off, increase weight by 900 kg.****With engine and wing anti-ice on, decrease weight by 1450 kg.****When operating in icing conditions during any part of the flight with forecast landing temperature is below 10°C, decrease weight by 20800 kg.**

ENGINE INOP

ADVISORY INFORMATION

**Go-Around Climb Gradient
Flaps 20, Gear Up**

Based on engine bleed for packs on or off, engine anti-ice on or off and wing anti-ice off.

OAT (°C)	REFERENCE GO-AROUND GRADIENT (%)						
	PRESSURE ALTITUDE (FT)						
	-2000	0	2000	4000	6000	8000	10000
54	6.55	5.65					
50	7.31	6.40	5.22				
46	8.10	7.13	5.96	4.72			
42	8.73	7.92	6.64	5.24	4.18		
38	9.28	8.57	7.23	5.73	4.61	3.55	
34	9.78	9.11	7.74	6.22	5.03	3.95	
30	9.79	9.64	8.20	6.67	5.46	4.32	3.27
26	9.80	9.66	8.58	7.06	5.83	4.69	3.60
22	9.81	9.67	8.62	7.38	6.14	4.95	3.87
18	9.81	9.68	8.63	7.44	6.27	5.13	3.99
14	9.82	9.68	8.64	7.45	6.32	5.35	4.15
10	9.83	9.69	8.64	7.45	6.32	5.36	4.38

Weight Adjustment

WEIGHT (1000 KG)	REFERENCE GO-AROUND GRADIENT (%)									
	0	1	2	3	4	5	6	7	8	9
280	-2.98	-3.42	-3.87	-4.31	-4.75	-5.13	-5.50	-5.88	-6.27	-6.65
260	-3.06	-3.33	-3.61	-3.88	-4.15	-4.46	-4.79	-5.12	-5.46	-5.80
240	-2.50	-2.72	-2.94	-3.16	-3.38	-3.65	-3.92	-4.19	-4.46	-4.74
220	-1.88	-2.03	-2.18	-2.33	-2.48	-2.67	-2.88	-3.07	-3.28	-3.48
200	-1.13	-1.19	-1.25	-1.31	-1.37	-1.49	-1.61	-1.72	-1.83	-1.94
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	1.16	1.30	1.44	1.57	1.71	1.85	1.99	2.13	2.29	2.45
140	2.57	2.92	3.26	3.60	3.95	4.27	4.59	4.94	5.31	5.70

Speed Adjustment

SPEED (KIAS)	WEIGHT ADJUSTED GO-AROUND GRADIENT (%)									
	0	1	2	3	4	5	6	7	8	9
VREF	-0.27	-0.28	-0.29	-0.30	-0.31	-0.32	-0.32	-0.33	-0.33	-0.32
VREF+5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VREF+10	0.16	0.16	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.15
VREF+15	0.27	0.26	0.26	0.26	0.27	0.28	0.28	0.26	0.24	0.22
VREF+20	0.33	0.32	0.32	0.33	0.34	0.35	0.34	0.32	0.28	0.23
VREF+25	0.35	0.34	0.33	0.34	0.35	0.36	0.35	0.31	0.26	0.20
VREF+30	0.32	0.30	0.29	0.28	0.29	0.28	0.26	0.22	0.17	0.11

With engine and wing anti-ice on, decrease gradient by 0.1%.

When operating in icing conditions during any part of the flight with forecast landing temperatures below 10°C, decrease gradient by 0.6%.

Quick Turnaround Limit Weight
Flaps 30 Limit Weight (1000 KG)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	235				
50	122	236	227			
45	113	238	229	220		
40	104	241	231	222	214	
35	95	243	233	224	216	208
30	86	245	235	226	217	209
25	77	247	238	228	219	211
20	68	249	240	230	221	213
15	59	252	242	232	223	215
10	50	254	244	235	225	217
5	41	257	247	237	228	219
0	32	259	249	239	230	221
-5	23	262	252	242	232	223
-10	14	265	254	244	234	225
-15	5	268	257	247	237	227
-20	-4	271	260	249	239	230
-30	-22	277	266	255	245	235
-40	-40	284	272	261	250	240
-50	-58	291	279	268	256	246
-54	-65	294	282	270	259	248

Increase weight by 2100 kg per 1% uphill slope. Decrease weight by 6100 kg per 1% downhill slope.
Increase weight by 5800 kg per 10 knots headwind. Decrease weight by 36600 kg per 10 knots tailwind.

Decrease weight by 13000 kg when one brake is deactivated. Decrease weight by 26800 kg when two brakes are deactivated.

After landing at weights exceeding those shown above, adjusted for slope and wind, wait at least 65 minutes and check that wheel thermal plugs have not melted before executing a takeoff.

As an alternate procedure, no waiting period is required if the BRAKE TEMP advisory message on EICAS is not displayed 10 to 15 minutes after parking.

Intentionally
Blank

Performance Dispatch

Chapter PD

Gear Down

Section 23

GEAR DOWN

Takeoff Climb Limit Weight
Flaps 15

AIRPORT OAT		TAKEOFF CLIMB WEIGHT (1000 KG)				
		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	178.8	171.4	164.4	155.0	145.9
52	126	183.8	171.4	164.3	154.9	145.9
50	122	188.6	172.3	164.3	154.9	145.8
48	118	193.3	176.8	164.2	154.8	145.8
46	115	198.1	181.1	165.1	154.8	145.7
44	111	202.7	185.5	169.3	154.7	145.7
42	108	207.3	189.7	173.2	155.6	145.7
40	104	211.9	194.0	177.1	159.5	145.6
38	100	216.8	198.1	181.0	163.3	146.5
36	97	221.7	202.3	184.9	167.1	150.1
34	93	226.5	207.4	188.8	170.8	153.7
32	90	231.3	212.5	192.7	174.5	157.3
30	86	236.1	217.4	197.8	178.2	160.9
28	82	240.7	222.2	202.8	182.0	164.5
26	79	245.3	226.9	207.7	186.9	168.1
24	75	247.6	231.4	212.5	191.7	171.7
22	72	247.6	235.9	217.0	196.4	176.4
20	68	247.6	238.1	221.5	200.9	181.0
18	64	247.6	238.1	225.8	205.3	185.4
16	61	247.6	238.1	227.8	209.6	189.7
14	57	247.6	238.0	227.7	212.9	193.9
12	54	247.6	238.0	227.7	212.9	198.0
10	50	247.6	238.0	227.7	212.9	199.9
-40	-40	246.8	237.3	226.5	213.7	200.6

With engine bleeds for packs off, increase weight by 100 kg.
With engine anti-ice on, decrease weight by 4000 kg.
With engine and wing anti-ice on, decrease weight by 4900 kg.

GEAR DOWN

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)			
		AIRPORT PRESSURE ALTITUDE (FT)			
°C	°F	0	1000	2000	3000
54	129	211.0			
52	126	216.2	208.1		
50	122	221.2	213.2	205.3	
48	118	226.2	218.3	210.1	201.8
46	115	231.0	223.1	214.9	205.9
44	111	236.0	227.8	219.5	210.1
42	108	241.2	232.4	224.0	214.0
40	104	246.4	236.9	228.2	217.9
38	100	250.3	241.2	232.2	221.7
36	97	254.1	244.8	236.0	225.4
34	93	257.9	248.5	239.3	228.8
32	90	261.5	251.9	242.6	232.0
30	86	265.2	255.2	245.8	235.1
28	82	265.1	258.4	248.6	238.0
26	79	265.2	258.6	251.5	240.7
24	75	265.2	258.6	252.0	243.3
22	72	265.2	258.7	252.1	243.8
20	68	265.3	258.7	252.1	243.9
18	64	265.3	258.8	252.2	243.9
16	61	265.4	258.8	252.2	244.0
14	57	265.4	258.8	252.3	244.0
12	54	265.5	258.9	252.3	244.0
10	50	265.5	258.9	252.3	244.1
0	32	265.8	259.1	252.5	244.3

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.

With engine bleed for packs off, increase weight by 700 kg.

With engine and wing anti-ice on, decrease weight by 1100 kg.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 26300 kg.

GEAR DOWN**Takeoff Obstacle Limit Weight****Based on engine bleed for packs on, engine anti-ice off and wing anti-ice off****Flaps 15****Sea Level, 29°C & Below, Zero Wind**

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	240.0										
20	228.8	240.0	240.0								
40	211.3	225.9	237.1	240.0							
60	197.8	212.7	224.2	233.3	240.0	240.0					
80	186.9	201.7	213.5	223.0	230.7	237.1	240.0	240.0			
100	177.7	192.3	204.3	214.1	222.1	228.8	234.5	239.1	240.0		
120	169.7	184.2	196.1	206.1	214.4	221.3	227.3	232.4	236.8	240.0	240.0
140	162.7	177.0	188.9	198.9	207.4	214.6	220.7	226.1	230.7	234.8	238.4
160	156.4	170.5	182.3	192.4	200.9	208.3	214.7	220.2	225.0	229.3	233.1
180	150.7	164.6	176.3	186.4	195.1	202.5	209.0	214.8	219.7	224.2	228.1
200		159.2	170.9	180.9	189.6	197.2	203.8	209.6	214.8	219.3	223.4
220		154.2	165.8	175.8	184.5	192.2	198.9	204.8	210.0	214.7	218.9
240		149.6	161.2	171.1	179.8	187.5	194.2	200.2	205.6	210.4	214.7
260			156.8	166.7	175.4	183.0	189.9	195.9	201.3	206.2	210.6
280			152.7	162.5	171.2	178.9	185.7	191.8	197.3	202.3	206.7
300			148.8	158.6	167.3	174.9	181.8	188.0	193.5	198.5	203.0

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustment

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
29 & BELOW	0	0	0	0	0	0	0
30	-1.1	-1.3	-1.6	-1.8	-2.1	-2.3	-2.6
32	-2.7	-3.6	-4.5	-5.3	-6.2	-7.1	-8.0
34	-4.3	-5.8	-7.3	-8.8	-10.3	-11.9	-13.4
36	-5.9	-8.1	-10.2	-12.3	-14.5	-16.6	-18.8
38	-7.5	-10.3	-13.1	-15.8	-18.6	-21.4	-24.1
40	-9.2	-12.5	-15.9	-19.3	-22.7	-26.1	-29.5
42	-10.5	-14.5	-18.6	-22.7	-26.8	-30.9	-35.0
44	-11.8	-16.5	-21.3	-26.1	-30.9	-35.7	-40.5
46	-13.1	-18.5	-24.0	-29.5	-35.0	-40.5	-46.0
48	-14.4	-20.5	-26.7	-32.9	-39.1	-45.3	-51.4
50	-15.7	-22.5	-29.4	-36.3	-43.2	-50.0	-56.9

GEAR DOWN

Takeoff Obstacle Limit Weight

Based on engine bleed for packs on, engine anti-ice off and wing anti-ice off
Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
S.L. & BELOW	0	0	0	0	0	0	0
1000	-5.4	-6.1	-6.9	-7.7	-8.4	-9.2	-10.0
2000	-10.8	-12.3	-13.8	-15.3	-16.9	-18.4	-19.9
3000	-15.7	-18.2	-20.6	-23.0	-25.4	-27.8	-30.3
4000	-20.7	-24.0	-27.3	-30.6	-34.0	-37.3	-40.6
5000	-24.8	-29.3	-33.7	-38.1	-42.5	-46.9	-51.3
6000	-29.0	-34.5	-40.0	-45.5	-51.0	-56.5	-62.0
7000	-32.5	-39.3	-46.0	-52.8	-59.5	-66.2	-73.0
8000	-36.0	-44.0	-52.0	-60.0	-68.0	-76.0	-84.0

Wind Adjustment

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
15 TW	-20.8	-20.6	-20.5	-20.4	-20.2	-20.1	-20.0
10 TW	-13.8	-13.8	-13.7	-13.6	-13.5	-13.4	-13.3
5 TW	-6.9	-6.9	-6.8	-6.8	-6.8	-6.7	-6.7
0	0	0	0	0	0	0	0
10 HW	3.5	3.0	2.5	2.0	1.5	1.0	0.5
20 HW	7.0	6.0	5.0	4.0	3.0	2.0	1.0
30 HW	10.5	9.0	7.5	6.0	4.5	3.0	1.5
40 HW	14.0	12.0	10.0	8.0	6.0	4.0	2.0

With engine bleed for packs off, increase weight by 300 kg.

With engine anti-ice on, decrease weight by 1000 kg.

With engine and wing anti-ice on, decrease weight by 1700 kg.

Long Range Cruise Altitude Capability

Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
300	13000	10400	7300
290	14600	12000	9100
280	16200	13700	11000
270	17800	15500	12800
260	19500	17200	14600
250	21100	18900	16400
240	22500	20500	18200
230	24000	22000	20100
220	25300	23600	21700
210	26300	25100	23300
200	27300	26100	25000
190	28300	27100	26000
180	29400	28200	27100
170	30600	29300	28200
160	32100	30500	29300
150	33800	32100	30600
140	35700	34000	32300

GEAR DOWN

**Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
329	292	261	236	216	200	187	175	165	156	148
497	441	393	356	326	300	281	263	247	234	222
663	589	526	476	435	400	374	351	330	312	296
828	736	657	595	544	500	468	438	412	389	370
992	882	788	714	653	600	561	526	495	468	444
1155	1028	918	832	762	700	655	614	578	546	519
1317	1172	1048	950	870	800	748	702	661	625	593
1478	1317	1178	1068	978	899	841	790	743	702	667
1638	1461	1308	1186	1086	999	935	877	826	781	742
1797	1603	1437	1304	1194	1100	1029	966	910	860	818
1955	1746	1565	1421	1303	1200	1124	1055	993	939	893
2112	1887	1693	1538	1410	1300	1218	1143	1077	1018	968
2269	2028	1821	1655	1519	1400	1312	1232	1160	1097	1043
2426	2170	1950	1773	1627	1500	1406	1320	1244	1177	1119
2582	2311	2078	1890	1736	1600	1500	1409	1328	1256	1194
2736	2451	2205	2007	1843	1700	1594	1497	1411	1335	1269
2890	2591	2332	2124	1951	1800	1688	1586	1495	1415	1345
3043	2730	2459	2240	2059	1900	1782	1675	1579	1494	1421
3196	2868	2585	2356	2166	2000	1876	1764	1663	1574	1497
3348	3007	2711	2472	2274	2100	1970	1853	1747	1654	1573
3499	3144	2837	2588	2382	2200	2065	1942	1831	1734	1649
3650	3281	2962	2704	2489	2300	2159	2031	1916	1814	1725
3800	3418	3087	2819	2596	2400	2253	2120	2000	1894	1801
3949	3555	3213	2935	2704	2500	2347	2208	2083	1973	1877
4098	3691	3338	3050	2811	2600	2440	2296	2167	2053	1953
4247	3827	3462	3166	2918	2700	2534	2385	2251	2133	2029

GEAR DOWN

**Long Range Cruise Trip Fuel and Time
Reference Fuel and Time Required**

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	7.5	0:52	7.2	0:50	6.9	0:48	6.7	0:47	6.6	0:46
300	11.1	1:16	10.6	1:13	10.1	1:10	9.7	1:07	9.5	1:05
400	14.8	1:40	14.0	1:35	13.3	1:31	12.7	1:27	12.3	1:24
500	18.5	2:03	17.5	1:58	16.6	1:52	15.8	1:47	15.2	1:43
600	22.2	2:27	20.9	2:20	19.8	2:13	18.8	2:07	18.1	2:02
700	26.0	2:50	24.5	2:42	23.1	2:33	22.0	2:26	21.1	2:20
800	29.8	3:13	28.0	3:03	26.4	2:54	25.1	2:46	24.0	2:38
900	33.7	3:36	31.7	3:25	29.8	3:14	28.2	3:05		
1000	37.5	3:59	35.3	3:46	33.2	3:34	31.4	3:24		
1100	41.5	4:21	39.0	4:07	36.7	3:55	34.7	3:44		
1200	45.4	4:43	42.7	4:28	40.2	4:15	38.0	4:03		
1300	49.5	5:05	46.5	4:49	43.7	4:35	41.3	4:22		
1400	53.5	5:27	50.3	5:10	47.2	4:54	44.6	4:40		
1500	57.7	5:49	54.1	5:31	50.8	5:14	48.0	4:59		
1600	61.8	6:10	58.0	5:51	54.5	5:33	51.4	5:18		
1700	66.1	6:31	61.9	6:11	58.1	5:53				
1800	70.3	6:53	65.9	6:31	61.8	6:12				
1900	74.6	7:13	69.9	6:51	65.6	6:31				
2000	78.9	7:34	73.9	7:11	69.3	6:50				

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	140	160	180	200	220
10	-1.2	-0.6	0.0	0.7	1.4
15	-1.8	-0.9	0.0	1.0	2.1
20	-2.4	-1.2	0.0	1.4	2.8
25	-3.0	-1.5	0.0	1.7	3.4
30	-3.6	-1.8	0.0	2.0	4.1
35	-4.2	-2.1	0.0	2.4	4.9
40	-4.8	-2.4	0.0	2.7	5.6
45	-5.4	-2.7	0.0	3.0	6.3
50	-6.0	-3.0	0.0	3.4	7.1
55	-6.6	-3.3	0.0	3.7	7.9
60	-7.2	-3.6	0.0	4.1	8.6
65	-7.8	-3.9	0.0	4.4	9.4
70	-8.4	-4.2	0.0	4.8	10.3
75	-9.1	-4.6	0.0	5.2	11.1

Based on VREF30+80 climb, LRC, and VREF30+80 descent.

GEAR DOWN

**Short Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
103	85	72	63	56	50	45	41	38	35	33
176	152	135	121	109	100	92	85	79	74	70
249	220	197	178	163	150	139	129	121	114	107
321	286	258	235	216	200	186	174	163	154	145
392	352	320	292	270	250	233	218	205	194	183
463	418	380	349	323	300	280	263	248	234	222
534	483	441	406	376	350	327	308	290	274	260
606	549	502	463	429	400	375	352	332	315	299
678	615	564	520	482	450	422	397	375	355	337
751	682	625	577	536	500	469	441	417	395	375

Trip Fuel and Time

AIR DIST (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		140	160	180	200	220	
50	FUEL (1000 KG)	1.8	2.0	2.2	2.3	2.5	0:15
	ALT (FT)	14000	12000	10000	10000	8000	
100	FUEL (1000 KG)	3.2	3.5	3.8	4.1	4.4	0:26
	ALT (FT)	24000	22000	20000	18000	16000	
150	FUEL (1000 KG)	4.4	4.8	5.2	5.7	6.2	0:36
	ALT (FT)	30000	26000	24000	22000	20000	
200	FUEL (1000 KG)	5.5	6.1	6.6	7.3	7.9	0:46
	ALT (FT)	30000	28000	26000	24000	20000	
250	FUEL (1000 KG)	6.6	7.3	8.1	8.8	9.6	0:56
	ALT (FT)	30000	28000	26000	24000	20000	
300	FUEL (1000 KG)	7.8	8.6	9.5	10.4	11.4	1:05
	ALT (FT)	30000	28000	26000	24000	20000	
350	FUEL (1000 KG)	8.9	9.9	10.9	12.1	13.2	1:15
	ALT (FT)	30000	28000	26000	22000	20000	
400	FUEL (1000 KG)	10.1	11.2	12.3	13.7	14.9	1:24
	ALT (FT)	30000	28000	26000	22000	20000	
450	FUEL (1000 KG)	11.3	12.5	13.8	15.3	16.7	1:34
	ALT (FT)	30000	28000	26000	22000	20000	
500	FUEL (1000 KG)	12.4	13.8	15.2	17.0	18.9	1:44
	ALT (FT)	30000	28000	26000	22000	18000	

GEAR DOWN

**Holding Planning
Flaps Up**

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)						
	PRESSURE ALTITUDE (FT)						
	1500	5000	10000	15000	20000	25000	30000
300	14180	14180	14220	14420			
280	13230	13230	13240	13350			
260	12320	12300	12290	12350	12610		
240	11430	11390	11370	11370	11500		
220	10580	10510	10480	10460	10510	10790	
200	10010	9680	9620	9590	9590	9730	
180	9200	8880	8790	8760	8730	8770	9030
160	8540	8440	8130	8090	8050	8050	8190
140	8230	8120	7800	7740	7820	7660	7750

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
300	13520	13510	13520	13640	
280	12630	12620	12600	12660	12940
260	11770	11740	11720	11750	11920
240	10910	10850	10830	10820	10910
220	10060	9990	9940	9920	9960
200	9460	9140	9070	9050	9050
180	8630	8530	8230	8200	8180
160	7920	7840	7530	7610	7580
140	7530	7450	7280	7190	7170

These tables include 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN
ENGINE INOP
MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
18	150.6		
17	156.6	149.1	
16	162.8	155.1	146.7
15	168.4	160.5	151.9
14	174.1	166.1	157.3
13	179.9	171.8	162.9
12	185.9	177.6	168.6
11	191.7	183.1	173.8
10	197.6	188.7	179.1
9	203.0	193.7	183.9
8	208.3	198.9	188.8
7	213.7	204.1	193.7
6	219.1	209.3	198.7
5	224.6	214.5	203.8
4	229.1	218.8	207.9
3	233.4	222.9	212.0
2	237.5	227.1	216.1

Anti-ice Adjustments

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG)					
	PRESSURE ALTITUDE (1000 FT)					
	8	10	12	14	16	18
ENGINE ONLY	-3.3	-3.4	-3.4	-3.2	-2.4	-1.4
ENGINE AND WING	-4.1	-4.3	-4.4	-4.4	-3.6	-2.4

Intentionally
Blank

Performance Dispatch**Text****Chapter PD****Section 24**

Introduction

This chapter contains self dispatch performance data intended primarily for use by flight crews in the event that information cannot be obtained from the airline dispatch office. The data provided is for a single takeoff flap at max takeoff thrust. The range of conditions covered is limited to those normally encountered in airline operation. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

Takeoff

The maximum allowable takeoff weight will be the least of the Field, Climb, Brake Energy, and Obstacle Limit Weights as determined from the following tables. Tire Limit is not shown as it is not limiting for the range of conditions shown in this chapter.

Field Limit Weight - Slope and Wind Corrections

These tables provide corrections to the field length available for the effects of runway slope and wind component along the runway. Enter the Slope Correction table with the available field length and runway slope to determine the slope corrected field length. Now enter the Wind Correction table with slope corrected field length and wind component to determine the slope and wind corrected field length.

Field and Climb Limit Weight

Tables are presented for selected airport pressure altitudes and show both Field and Climb Limit Weights. Enter the appropriate table for pressure altitude with "Slope and Wind Corrected Field Length" determined above and airport OAT to obtain Field Limit Weight. Also read Climb Limit Weight for the same OAT. Intermediate altitudes may be interpolated or use next higher altitude.

Obstacle Limit Weight

This table provides obstacle limit weights for reference airport conditions based on obstacle height above the runway surface and distance from brake release. Enter the correction tables to correct the reference Obstacle Limit Weight for the effects of OAT, pressure altitude and wind as indicated. In the case of multiple obstacles, enter the tables successively with each obstacle and determine the most limiting weight.

Brake Energy Limits VMBE

Tables are presented to determine the Maximum Brake Energy Speed VMBE. Compliance with this limitation is required to ensure that the brakes have enough capacity to execute a maximum effort stop from V1 without the use of thrust reversers. Enter the upper table with pressure altitude and OAT to determine the reference VMBE. Then enter the lower table with the reference VMBE and brake release weight to determine VMBE for a specific takeoff. Adjust for slope, wind and deactivated brakes as described below the table. The resulting VMBE must be greater than or equal to V1. If VMBE is less than V1, brake release weight must be decreased by the amount shown below the table.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table as well as FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Normal takeoff speeds, V1, VR, and V2 are read from the table by entering with takeoff flap setting and brake release weight. Use the tables provided to correct takeoff speeds for altitude and actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind corrections to V1 are obtained by entering the Slope and Wind V1 Adjustment Table.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Brakes Deactivated

When operating with brakes deactivated, the field and brake energy limit weights and the V1 and VMBE must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway limited weight by 3500 kg and the V1 associated with the reduced weight by one knot. With two brakes deactivated, reduce the normal runway limited weight by 7300 kg and the V1 associated with the reduced weight by three knots. If the resulting V1 is less than V1(MCG), takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate stop distance corrected for wind and slope exceeds approximately 1540m for one brake deactivated or 1610 m for two brakes deactivated.

For brake(s) deactivated, reduce VMBE by the amount shown on the Brake Energy Limit VMBE Chart. If the resulting VMBE is less than V1, the brake release weight must be reduced according to the instructions on the brake energy limit chart. The resulting V1 must not be less than V1(MCG). Determine VR and V2 for the actual weight.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

Enroute

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited

condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination. Data is based on economy climb and descent speeds, and Long Range Cruise with normal engine bleed for air conditioning. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine trip fuel and time for a constant altitude cruise, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time Table with air distance from the Ground to Air Miles Conversion Table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment Table with the Reference Fuel and the planned landing weight to obtain fuel required at the planned landing weight.

Long Range Cruise Step Climb Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination when flying a step climb profile. Step climb profiles are based on 4000 ft step climbs to keep the flight within 2000 ft of the optimum altitude for the current cruise weight. To determine trip fuel and time, enter the Ground to Air Miles Conversion table and determine air distance as discussed above. Then enter the Trip Fuel and Time required with air distance and planned landing weight to read trip fuel. Continue across the table to read trip time.

Short Trip Fuel and Time

These tables are provided to determine trip fuel and time for short distances or alternates. The data considers the use of the FMC short trip optimum altitude. Obtain air distance from upper table using the ground distance and wind component to the alternate. Enter Trip Fuel and Time table with air distance and read trip fuel required for the expected landing weight, together with time to alternate at right. For distances greater than shown or other altitudes, use the Long Range Cruise Trip Fuel and Time tables.

Holding Planning

These tables provide total fuel flow information necessary for planning Flaps Up and Flaps 1 holding and reserve fuel requirements. Data is based on the FMC holding speed schedule which is the higher of the maximum endurance and flaps up maneuver speeds. As noted, the fuel flow is based on flight in a racetrack holding pattern. For holding in straight and level flight, reduce table values by 5%.

Oxygen Requirements

Flight Crew System

Regulations require that sufficient oxygen be provided to the flight crew to account for the greater of supplemental breathing oxygen in the event of a cabin depressurization or protective breathing in the event of smoke or harmful fumes in the flight deck. The oxygen quantity associated with these requirements is achieved with the minimum dispatch oxygen cylinder pressure. Enter the Crew Oxygen Requirements table with the number of crew plus observers using oxygen and read the minimum cylinder pressure required for the appropriate bottle temperature.

An additional quantity of oxygen is required when flight altitudes above 41000 ft are planned. Regulations require that one active duty pilot must don the oxygen mask and breathe diluted oxygen for the duration of the flight above 41000 ft. The additional quantity of oxygen required is 2.05 liters/person/minute (1.2 psi/person/minute for the single cylinder system), or 13 liters/person/minute (8 psi/person/minute) if 100% oxygen is selected during normal usage.

Net Level Off Weight

The Net Level Off Weight table is provided to determine terrain clearance capability in straight and level flight following an engine failure. Regulations require terrain clearance planning based on net performance which is the gross (or actual) gradient performance degraded by 1.1%. In addition, the net level off pressure altitude must clear the terrain by 1000 ft.

To determine the maximum weight for terrain clearance, enter the table with required net level off pressure altitude and expected ISA deviation to obtain weight. Adjust weight for anti-ice operation as noted below the table.

Extended Range Operations

Regulations require that flights conducted over a route that contains a point further than one hour's time at "normal one engine inoperative speed" from an adequate diversion airport comply with rules set up specifically for "Extended Range Operation with Two Engine airplanes". This section provides reserve fuel planning information for the "Critical Fuel Scenario" based on two engine operation at Long Range Cruise as well as single engine operation at Long Range Cruise.

Critical Fuel Reserves

Enter Ground to Air Mile Conversion table with forecast wind and ground distance to diversion airport from critical point to obtain air distance. Now enter Critical Fuel table with air distance and expected weight at the critical point and read required fuel. Apply the noted fuel adjustments as necessary. Regulations require a 5% allowance for performance deterioration unless a value has been established by the operator for in-service deterioration.

As noted below each table, the fuel required is the greater of the two engine fuel and the single engine fuel. This fuel is compared to the amount of fuel normally onboard the airplane at that point in the route. If the fuel required by the critical fuel reserves exceeds the amount of fuel normally expected, the fuel load must be adjusted accordingly.

Landing

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for Flaps 30.

Maximum landing weight is the lowest of the field length limit weight, climb limit weight or maximum certified landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required.

Go-Around Climb Gradient

Enter the Reference Go-around Gradient table with airport OAT and pressure altitude to determine the reference Go-Around Gradient. Then adjust the reference gradient for airplane weight and speed using the tables provided to determine the weight and speed adjusted Go-Around Gradient. Apply the necessary engine bleed corrections as noted. Note that data is for one engine inoperative.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted adjustments as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent takeoff, or ensure the brake temperature is within limits using the alternate procedure described on the page.

Gear Down

This section provides flight planning data for revenue operation with gear down.

Takeoff/Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to determine Takeoff Climb Limit Weight with gear down. Correct the weight obtained for engine bleed configuration as required.

The remaining gear down tables in this section are identical in format and usage to the corresponding gear up tables previously described.

Intentionally
Blank

Performance Dispatch**Chapter PD****Table of Contents****Section 30****777-200LR GE90-110B1L KG FAA****Takeoff..... PD.30.1**

Minimum Takeoff Weight.....	PD.30.1
Takeoff Field Corrections - Dry Runway.....	PD.30.2
Takeoff Field & Climb Limit Weights - Dry Runway.....	PD.30.3
Takeoff Field Corrections - Wet Runway.....	PD.30.6
Takeoff Field & Climb Limit Weights - Wet Runway.....	PD.30.7
Takeoff Obstacle Limit Weight.....	PD.30.10
Tire Speed Limit.....	PD.30.11
Takeoff Speeds - Dry Runway.....	PD.30.12
Takeoff Speeds - Wet Runway.....	PD.30.14

Enroute PD.31.1

Long Range Cruise Maximum Operating Altitude.....	PD.31.1
Long Range Cruise Trip Fuel and Time.....	PD.31.3
Long Range Cruise Step Climb Trip Fuel and Time.....	PD.31.5
Short Trip Fuel and Time.....	PD.31.6
Holding Planning.....	PD.31.7
Crew Oxygen Requirements.....	PD.31.7
Net Level Off Weight.....	PD.31.8
Decompression Critical Fuel Reserves - LRC Cruise.....	PD.31.9
Driftdown Critical Fuel Reserves - LRC Driftdown/Cruise.....	PD.31.11

Landing PD.32.1

Landing Field Limit Weight - Dry Runway.....	PD.32.1
Landing Field Limit Weight - Wet Runway.....	PD.32.2
Landing Climb Limit Weight.....	PD.32.3
Go-Around Climb Gradient.....	PD.32.4
Quick Turnaround Limit Weight.....	PD.32.5

Gear Down	PD.33.1
Takeoff Climb Limit Weight	PD.33.1
Landing Climb Limit Weight	PD.33.2
Takeoff Obstacle Limit Weight	PD.33.3
Long Range Cruise Altitude Capability	PD.33.5
Long Range Cruise Trip Fuel and Time	PD.33.6
Short Trip Fuel and Time	PD.33.8
Holding Planning	PD.33.9
Net Level Off Weight	PD.33.10
Text	PD.34.1
Introduction	PD.34.1
Takeoff	PD.34.1
Enroute	PD.34.4
Landing	PD.34.7
Gear Down	PD.34.8

Performance Dispatch**Chapter PD****Takeoff****Section 30****Minimum Takeoff Weight****Weight Limit (1000 KG)****Flaps 15****Based on engine bleed for packs on and anti-ice off.**

OAT (°C)	AIRPORT PRESSURE ALTITUDE (FT)								
	S.L. & BELOW	1000	2000	3000	4000	5000	6000	7000	8000 & ABOVE
50	159.8								
45	169.6	162.9	155.7						
40	179.0	172.0	164.8	158.3					
35	187.6	180.4	172.9	166.2	159.6				
30	190.0	186.2	179.6	172.7	166.0	159.7			
25	190.2	186.4	182.0	177.3	171.4	165.7	158.3		
20	190.5	186.6	182.1	177.4	172.8	168.1	161.8	154.4	
15	190.7	186.7	182.3	177.6	172.9	168.3	162.8	156.3	
10	190.9	186.9	182.4	177.7	173.0	168.4	162.9	156.4	
0 & BELOW	191.2	187.2	182.7	178.0	173.3	168.6	163.1	156.5	

Light weight takeoffs at the GE90-110B1L thrust rating may be limited by minimum takeoff weight in order to maintain airplane controllability during takeoff. For takeoff at weights below the minimum takeoff weight, use of a lower thrust rating and/or the assumed temperature method of thrust reduction is required.

Takeoff Field Corrections - Dry Runway
Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH (M)								
	RUNWAY SLOPE (%)								
	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
1200	1250	1240	1220	1210	1200	1190	1180	1160	1150
1400	1470	1450	1430	1420	1400	1380	1350	1330	1310
1600	1690	1670	1640	1620	1600	1570	1530	1500	1470
1800	1910	1880	1850	1830	1800	1760	1710	1670	1620
2000	2120	2090	2060	2030	2000	1950	1890	1840	1780
2200	2340	2310	2270	2240	2200	2130	2070	2000	1940
2400	2560	2520	2480	2440	2400	2320	2250	2170	2100
2600	2780	2730	2690	2640	2600	2510	2430	2340	2250
2800	3000	2950	2900	2850	2800	2700	2610	2510	2410
3000	3220	3160	3110	3050	3000	2890	2780	2680	2570
3200	3440	3380	3320	3260	3200	3080	2960	2850	2730
3400	3650	3590	3530	3460	3400	3270	3140	3010	2890
3600	3870	3800	3740	3670	3600	3460	3320	3180	3040
3800	4090	4020	3950	3870	3800	3650	3500	3350	3200
4000	4310	4230	4160	4080	4000	3840	3680	3520	3360
4200	4530	4450	4360	4280	4200	4030	3860	3690	3520
4400	4750	4660	4570	4490	4400	4220	4040	3860	3670
4600	4970	4870	4780	4690	4600	4410	4220	4020	3830
4800	5180	5090	4990	4900	4800	4600	4390	4190	3990
5000	5400	5300	5200	5100	5000	4790	4570	4360	4150

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M)							
	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1200	890	990	1100	1200	1270	1350	1430	1510
1400	1060	1170	1290	1400	1480	1560	1650	1740
1600	1220	1350	1470	1600	1690	1770	1870	1960
1800	1390	1530	1660	1800	1890	1990	2080	2180
2000	1550	1700	1850	2000	2100	2200	2300	2400
2200	1720	1880	2040	2200	2300	2410	2520	2630
2400	1890	2060	2230	2400	2510	2620	2730	2850
2600	2050	2230	2420	2600	2710	2830	2950	3070
2800	2220	2410	2610	2800	2920	3040	3170	3300
3000	2380	2590	2790	3000	3130	3250	3380	3520
3200	2550	2770	2980	3200	3330	3460	3600	3740
3400	2710	2940	3170	3400	3540	3680	3820	3970
3600	2880	3120	3360	3600	3740	3890	4040	4190
3800	3050	3300	3550	3800	3950	4100	4250	4410
4000	3210	3470	3740	4000	4150	4310	4470	4630
4200	3380	3650	3930	4200	4360	4520	4690	4860
4400	3540	3830	4110	4400	4560	4730	4900	5080
4600	3710	4010	4300	4600	4770	4940	5120	5300
4800	3880	4180	4490	4800	4980	5150	5340	5530
5000	4040	4360	4680	5000	5180	5370	5560	5750

Takeoff Field & Climb Limit Weights - Dry Runway**Flaps 15****Sea Level Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
1690	279.8	252.1	250.5	248.5	247.3	246.5	244.6	239.4	231.6	225.0	218.2
1800	289.9	261.2	259.5	257.5	256.3	255.5	253.5	248.1	240.0	233.2	226.2
2000	306.0	275.8	274.0	271.8	270.6	269.7	267.7	261.9	253.5	246.3	238.9
2200	321.8	290.2	288.3	286.1	284.8	283.9	281.7	275.7	266.9	259.4	251.6
2400	337.2	304.4	302.5	300.2	298.8	297.9	295.6	289.4	280.2	272.4	264.4
2600	351.3	317.4	315.3	312.9	311.5	310.6	308.3	301.8	292.3	284.2	275.9
2800	364.0	329.0	326.9	324.4	322.9	322.0	319.6	312.9	303.1	294.8	286.2
3000	375.3	339.2	337.0	334.5	333.0	332.0	329.5	322.6	312.5	303.9	295.1
3200	378.7	348.9	346.7	344.0	342.5	341.5	338.9	331.9	321.4	312.6	303.5
3400	378.7	358.2	355.9	353.2	351.6	350.6	348.0	340.7	330.0	320.9	311.6
3600	378.7	367.1	364.8	362.0	360.4	359.3	356.6	349.2	338.2	328.9	319.3
3800	378.7	375.4	373.0	370.2	368.5	367.4	364.7	357.1	345.9	336.4	326.7
4000	378.7	378.7	378.7	378.1	376.4	375.3	372.5	364.8	353.4	343.7	333.8
4200	378.7	378.7	378.7	378.7	378.7	378.7	378.7	372.3	360.7	350.9	340.8
4400	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	367.9	357.9	347.6
4600	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	374.9	364.8	354.3
4800	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	371.5	360.9
5000	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.1	367.4
CLIMB LIMIT WT (1000 KG)	351.5	350.9	350.7	350.4	350.2	350.1	349.7	336.8	319.5	305.3	290.6

2000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
1690	263.3	238.9	237.4	235.5	234.4	233.7	227.8	222.3	214.7	208.1	201.0
1800	272.8	247.5	246.0	244.1	243.0	242.2	236.1	230.4	222.6	215.7	208.4
2000	287.9	261.4	259.7	257.7	256.6	255.7	249.4	243.4	235.1	227.9	220.1
2200	302.9	275.2	273.4	271.3	270.1	269.3	262.6	256.3	247.7	240.1	232.1
2400	317.6	288.8	287.0	284.9	283.6	282.7	275.8	269.3	260.3	252.5	244.1
2600	331.0	301.2	299.4	297.1	295.8	294.9	287.7	281.0	271.7	263.6	254.9
2800	343.1	312.3	310.4	308.1	306.7	305.8	298.4	291.4	281.8	273.4	264.5
3000	353.7	322.0	320.0	317.6	316.2	315.3	307.7	300.5	290.6	282.0	272.7
3200	363.8	331.2	329.2	326.7	325.3	324.3	316.4	309.0	298.9	290.0	280.5
3400	373.5	340.0	337.9	335.4	333.9	332.9	324.9	317.2	306.8	297.7	287.9
3600	378.7	348.5	346.3	343.7	342.2	341.2	332.9	325.1	314.4	305.1	295.1
3800	378.7	356.4	354.2	351.6	350.0	348.9	340.5	332.6	321.7	312.1	301.9
4000	378.7	364.1	361.9	359.2	357.6	356.5	347.9	339.8	328.7	319.0	308.6
4200	378.7	371.6	369.3	366.6	365.0	363.9	355.2	346.9	335.6	325.7	315.1
4400	378.7	378.7	376.7	373.9	372.2	371.1	362.2	353.9	342.3	332.3	321.5
4600	378.7	378.7	378.7	378.7	378.7	378.2	369.2	360.7	349.0	338.8	327.8
4800	378.7	378.7	378.7	378.7	378.7	378.7	376.0	367.3	355.5	345.1	334.0
5000	378.7	378.7	378.7	378.7	378.7	378.7	378.7	373.9	361.9	351.4	340.1
CLIMB LIMIT WT (1000 KG)	335.7	335.5	335.4	335.2	335.1	334.9	322.6	310.6	294.2	280.3	266.6

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.

With engine and wing anti-ice on, decrease field limit weight by 2050 kg and climb limit weight by 2100 kg.

Takeoff Field & Climb Limit Weights - Dry Runway

Flaps 15

4000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
1690	246.9	225.1	223.7	221.9	219.6	217.6	211.6	206.3	198.5	192.1	186.3
1800	255.8	233.3	231.8	230.0	227.6	225.5	219.3	213.8	205.8	199.2	193.2
2000	270.1	246.4	244.8	242.9	240.4	238.2	231.7	225.9	217.4	210.5	204.2
2200	284.3	259.5	257.9	255.9	253.2	250.9	244.1	238.1	229.2	222.0	215.4
2400	298.3	272.6	270.9	268.8	266.0	263.7	256.6	250.4	241.1	233.7	226.8
2600	311.0	284.4	282.6	280.5	277.6	275.2	267.9	261.4	251.8	244.1	237.0
2800	322.4	294.9	293.1	290.9	287.9	285.4	277.9	271.2	261.3	253.3	246.0
3000	332.4	304.1	302.2	300.0	296.9	294.3	286.5	279.6	269.4	261.2	253.6
3200	341.9	312.7	310.8	308.5	305.3	302.7	294.7	287.6	277.1	268.6	260.8
3400	351.1	321.0	319.1	316.7	313.5	310.7	302.5	295.2	284.4	275.8	267.7
3600	359.8	329.0	327.1	324.6	321.3	318.5	310.0	302.6	291.5	282.6	274.4
3800	367.9	336.6	334.5	332.0	328.6	325.8	317.2	309.6	298.3	289.2	280.8
4000	375.8	343.9	341.8	339.3	335.8	332.9	324.1	316.3	304.9	295.6	287.1
4200	378.7	351.0	348.9	346.3	342.8	339.8	330.9	323.0	311.3	301.9	293.2
4400	378.7	358.1	355.9	353.3	349.7	346.7	337.6	329.6	317.7	308.1	299.3
4600	378.7	364.9	362.8	360.1	356.4	353.4	344.1	336.0	323.9	314.2	305.2
4800	378.7	371.7	369.5	366.7	363.0	359.9	350.6	342.3	330.1	320.2	311.1
5000	378.7	378.3	376.0	373.3	369.5	366.4	356.9	348.5	336.1	326.1	316.9
CLIMB LIMIT WT (1000 KG)	317.5	317.3	317.2	317.1	313.2	309.7	297.2	286.7	271.5	259.0	248.1

6000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
1690	231.6	211.1	209.8	206.5	203.2	200.6	194.9	190.0	183.2	177.6	172.2
1800	240.0	218.9	217.5	214.1	210.6	208.0	202.0	197.0	189.9	184.2	178.6
2000	253.5	231.2	229.7	226.2	222.5	219.8	213.5	208.2	200.7	194.7	188.8
2200	266.9	243.6	242.1	238.4	234.6	231.7	225.1	219.6	211.8	205.5	199.4
2400	280.2	256.1	254.5	250.7	246.7	243.7	236.9	231.1	223.1	216.5	210.2
2600	292.3	267.3	265.7	261.7	257.6	254.5	247.4	241.5	233.1	226.3	219.8
2800	303.1	277.3	275.6	271.5	267.3	264.0	256.8	250.6	242.0	235.0	228.2
3000	312.5	285.9	284.2	280.0	275.6	272.3	264.8	258.4	249.5	242.3	235.3
3200	321.4	294.1	292.3	287.9	283.4	280.0	272.3	265.7	256.6	249.2	242.0
3400	330.0	301.9	300.0	295.6	290.9	287.4	279.5	272.8	263.4	255.7	248.4
3600	338.2	309.4	307.5	302.9	298.2	294.6	286.5	279.6	270.0	262.2	254.6
3800	345.9	316.5	314.6	309.9	305.1	301.4	293.1	286.1	276.3	268.3	260.6
4000	353.4	323.4	321.5	316.7	311.8	308.1	299.6	292.5	282.5	274.3	266.4
4200	360.7	330.2	328.3	323.4	318.4	314.6	306.0	298.7	288.5	280.2	272.2
4400	367.9	336.9	334.9	330.0	324.9	321.0	312.2	304.8	294.5	286.1	277.9
4600	374.9	343.5	341.4	336.4	331.2	327.3	318.4	310.9	300.4	291.8	283.6
4800	378.7	349.9	347.8	342.7	337.5	333.5	324.5	316.8	306.2	297.5	289.1
5000	378.7	356.2	354.1	348.9	343.6	339.6	330.4	322.7	311.9	303.1	294.6
CLIMB LIMIT WT (1000 KG)	297.9	297.9	297.8	293.5	287.5	282.8	272.4	263.5	250.7	240.1	230.1

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.

With engine and wing anti-ice on, decrease field limit weight by 2050 kg and climb limit weight by 2100 kg.

Takeoff Field & Climb Limit Weights - Dry Runway**Flaps 15****8000 FT Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
1690	214.4	194.4	191.9	187.2	183.8	181.7	176.4	171.6	165.2	160.2	155.2
1800	222.3	201.5	199.0	194.1	190.6	188.4	183.0	178.0	171.3	166.1	161.0
2000	234.8	212.9	210.2	205.1	201.5	199.2	193.4	188.1	181.2	175.7	170.3
2200	247.4	224.5	221.7	216.4	212.6	210.2	204.2	198.6	191.4	185.6	180.0
2400	260.0	236.3	233.4	227.8	223.9	221.4	215.1	209.4	201.9	195.9	190.1
2600	271.3	246.8	243.8	238.1	234.0	231.4	224.9	219.0	211.2	205.0	199.0
2800	281.4	256.1	253.0	247.1	242.9	240.2	233.5	227.4	219.3	213.0	206.7
3000	290.2	264.1	260.9	254.8	250.4	247.7	240.8	234.5	226.2	219.6	213.2
3200	298.5	271.6	268.3	262.0	257.5	254.7	247.6	241.1	232.5	225.8	219.2
3400	306.4	278.8	275.4	268.9	264.3	261.4	254.2	247.5	238.7	231.8	224.9
3600	314.0	285.8	282.3	275.7	271.0	268.0	260.5	253.7	244.7	237.6	230.6
3800	321.3	292.4	288.9	282.1	277.3	274.2	266.6	259.7	250.5	243.2	236.1
4000	328.3	298.9	295.3	288.4	283.5	280.4	272.6	265.5	256.1	248.8	241.5
4200	335.2	305.2	301.6	294.5	289.6	286.4	278.5	271.3	261.7	254.3	246.9
4400	341.9	311.5	307.7	300.6	295.6	292.3	284.3	277.0	267.3	259.7	252.1
4600	348.5	317.7	313.8	306.6	301.5	298.2	290.1	282.6	272.7	265.0	257.3
4800	355.0	323.7	319.8	312.5	307.3	303.9	295.7	288.1	278.1	270.3	262.5
5000	361.4	329.6	325.7	318.2	313.0	309.6	301.2	293.6	283.4	275.5	267.6
CLIMB LIMIT WT (1000 KG)	273.7	273.7	270.5	262.7	256.7	253.2	243.8	234.7	222.5	213.2	204.0

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.

With engine and wing anti-ice on, decrease field limit weight by 2050 kg and climb limit weight by 2100 kg.

Takeoff Field Corrections - Wet Runway
Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH (M)								
	RUNWAY SLOPE (%)								
	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
1200	1250	1230	1220	1210	1200	1190	1170	1160	1150
1400	1470	1450	1430	1420	1400	1380	1360	1340	1320
1600	1690	1670	1640	1620	1600	1570	1550	1520	1490
1800	1910	1880	1850	1830	1800	1770	1730	1700	1660
2000	2130	2100	2060	2030	2000	1960	1920	1880	1840
2200	2350	2310	2270	2240	2200	2150	2100	2060	2010
2400	2570	2530	2480	2440	2400	2350	2290	2240	2180
2600	2790	2740	2690	2650	2600	2540	2480	2420	2350
2800	3010	2960	2900	2850	2800	2730	2660	2600	2530
3000	3230	3170	3120	3060	3000	2930	2850	2780	2700
3200	3450	3390	3330	3260	3200	3120	3040	2950	2870
3400	3670	3600	3540	3470	3400	3310	3220	3130	3050
3600	3890	3820	3750	3670	3600	3500	3410	3310	3220
3800	4110	4030	3960	3880	3800	3700	3600	3490	3390
4000	4330	4250	4170	4080	4000	3890	3780	3670	3560
4200	4550	4460	4380	4290	4200	4080	3970	3850	3740
4400	4770	4680	4590	4490	4400	4280	4150	4030	3910
4600	4990	4900	4800	4700	4600	4470	4340	4210	4080
4800	5210	5110	5010	4900	4800	4660	4530	4390	4250
5000	5430	5330	5220	5110	5000	4860	4710	4570	4430

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M)							
	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1200	860	970	1090	1200	1280	1360	1450	1540
1400	1020	1150	1270	1400	1480	1570	1670	1770
1600	1190	1330	1460	1600	1690	1790	1890	2000
1800	1360	1510	1650	1800	1890	2000	2110	2220
2000	1530	1680	1840	2000	2100	2210	2320	2450
2200	1690	1860	2030	2200	2300	2420	2540	2680
2400	1860	2040	2220	2400	2510	2630	2760	2910
2600	2030	2220	2410	2600	2710	2840	2980	3140
2800	2190	2400	2600	2800	2920	3050	3200	3360
3000	2360	2570	2790	3000	3120	3260	3420	3590
3200	2530	2750	2980	3200	3320	3470	3630	3820
3400	2690	2930	3160	3400	3530	3680	3850	4050
3600	2860	3110	3350	3600	3730	3890	4070	4280
3800	3030	3290	3540	3800	3940	4100	4290	4500
4000	3200	3460	3730	4000	4140	4310	4510	4730
4200	3360	3640	3920	4200	4350	4520	4730	4960
4400	3530	3820	4110	4400	4550	4730	4940	5190
4600	3700	4000	4300	4600	4750	4940	5160	5420
4800	3860	4180	4490	4800	4960	5150	5380	5640
5000	4030	4350	4680	5000	5160	5360	5600	5870

Takeoff Field & Climb Limit Weights - Wet Runway**Flaps 15****Sea Level Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
2240	320.5	286.5	284.5	282.1	280.7	279.8	277.5	271.1	261.7	253.9	245.8
2400	331.8	296.6	294.5	292.1	290.6	289.6	287.2	280.6	270.9	262.8	254.4
2600	348.4	311.6	309.4	306.9	305.3	304.3	301.8	294.9	284.8	276.3	267.6
2800	362.9	324.5	322.3	319.6	318.0	316.9	314.3	307.1	296.6	287.7	278.6
3000	375.1	335.1	332.8	330.0	328.3	327.2	324.5	317.0	306.0	296.8	287.3
3200	378.7	345.7	343.3	340.4	338.6	337.5	334.7	326.9	315.4	305.8	296.0
3400	378.7	356.0	353.5	350.5	348.7	347.5	344.6	336.5	324.6	314.7	304.5
3600	378.7	366.0	363.4	360.3	358.4	357.2	354.2	345.8	333.6	323.3	312.7
3800	378.7	375.5	372.8	369.6	367.7	366.5	363.4	354.7	342.2	331.6	320.7
4000	378.7	378.7	378.7	378.7	376.7	375.4	372.3	363.4	350.5	339.6	328.5
4200	378.7	378.7	378.7	378.7	378.7	378.7	378.7	371.9	358.6	347.5	336.1
4400	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	366.6	355.2	343.6
4600	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	374.3	362.7	350.8
4800	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	370.0	357.8
5000	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	377.0	364.7
5200	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	371.3
5400	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	377.8
5600	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7
CLIMB LIMIT WT (1000 KG)	351.5	350.9	350.7	350.4	350.2	350.1	349.7	336.8	319.5	305.3	290.6

2000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
2240	299.0	270.3	268.5	266.3	265.0	264.1	257.1	250.5	241.5	234.0	226.5
2400	309.6	279.9	278.0	275.7	274.3	273.4	266.1	259.2	250.0	242.2	234.4
2600	325.1	294.1	292.2	289.7	288.3	287.4	279.7	272.6	262.9	254.7	246.6
2800	338.6	306.3	304.2	301.7	300.3	299.2	291.3	283.8	273.7	265.2	256.8
3000	349.8	316.2	314.0	311.4	309.9	308.8	300.5	292.8	282.3	273.4	264.6
3200	361.1	326.0	323.8	321.0	319.4	318.3	309.7	301.6	290.7	281.5	272.3
3400	371.9	335.6	333.3	330.5	328.8	327.7	318.7	310.3	299.0	289.4	279.9
3600	378.7	344.9	342.5	339.6	337.9	336.7	327.4	318.8	307.1	297.2	287.4
3800	378.7	353.8	351.3	348.3	346.6	345.4	335.9	327.0	314.9	304.8	294.7
4000	378.7	362.4	359.9	356.8	355.0	353.8	344.0	334.9	322.6	312.2	301.8
4200	378.7	370.8	368.3	365.1	363.3	362.0	352.0	342.7	330.1	319.4	308.8
4400	378.7	378.7	376.4	373.2	371.3	370.0	359.8	350.3	337.3	326.4	315.6
4600	378.7	378.7	378.7	378.7	378.7	377.8	367.4	357.6	344.4	333.3	322.2
4800	378.7	378.7	378.7	378.7	378.7	378.7	374.8	364.8	351.3	340.0	328.7
5000	378.7	378.7	378.7	378.7	378.7	378.7	378.7	371.8	358.1	346.5	334.9
5200	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.6	364.6	352.8	341.0
5400	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	370.9	358.9	347.0
5600	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	377.1	364.9	352.8
CLIMB LIMIT WT (1000 KG)	335.7	335.5	335.4	335.2	335.1	334.9	322.6	310.6	294.2	280.3	266.6

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.

With engine and wing anti-ice on, decrease field limit weight by 2200 kg and climb limit weight by 2100 kg.

Takeoff Field & Climb Limit Weights - Wet Runway**Flaps 15****4000 FT Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
2240	280.1	253.7	252.0	249.9	247.1	244.7	237.6	231.7	223.4	216.7	210.6
2400	290.0	262.6	260.8	258.6	255.7	253.2	245.9	239.7	231.2	224.2	217.8
2600	304.7	276.0	274.2	272.0	268.9	266.3	258.6	252.2	243.3	236.0	229.3
2800	317.3	287.4	285.5	283.2	280.0	277.3	269.3	262.6	253.3	245.7	238.7
3000	327.6	296.5	294.5	292.1	288.8	286.0	277.6	270.6	260.9	253.1	245.8
3200	337.9	305.6	303.5	300.9	297.5	294.6	285.9	278.6	268.5	260.4	252.8
3400	347.9	314.4	312.3	309.6	306.0	303.0	294.0	286.5	276.0	267.5	259.7
3600	357.6	323.0	320.8	318.0	314.3	311.2	301.9	294.1	283.3	274.6	266.4
3800	366.9	331.3	329.0	326.2	322.4	319.2	309.6	301.6	290.5	281.5	273.2
4000	375.9	339.3	337.0	334.1	330.2	326.9	317.1	308.9	297.5	288.3	279.8
4200	378.7	347.2	344.8	341.9	337.9	334.5	324.5	316.1	304.4	294.9	286.2
4400	378.7	354.9	352.4	349.4	345.3	341.9	331.6	323.0	311.1	301.4	292.5
4600	378.7	362.4	359.9	356.8	352.6	349.1	338.6	329.8	317.6	307.7	298.6
4800	378.7	369.6	367.1	363.9	359.7	356.1	345.4	336.4	324.0	313.9	304.6
5000	378.7	376.7	374.1	370.9	366.6	362.9	352.0	342.9	330.2	319.9	310.4
5200	378.7	378.7	378.7	377.7	373.3	369.5	358.4	349.1	336.2	325.7	316.0
5400	378.7	378.7	378.7	378.7	378.7	376.0	364.6	355.2	342.1	331.4	321.6
5600	378.7	378.7	378.7	378.7	378.7	378.7	370.7	361.1	347.7	336.9	326.9
CLIMB LIMIT WT (1000 KG)	317.5	317.3	317.2	317.1	313.2	309.7	297.2	286.7	271.5	259.0	248.1

6000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
2240	261.6	237.0	235.4	231.6	228.1	225.4	219.2	214.1	206.9	201.0	195.3
2400	270.8	245.3	243.6	239.7	236.0	233.2	226.8	221.5	214.0	207.9	202.0
2600	284.7	258.0	256.3	252.2	248.3	245.4	238.7	233.1	225.3	219.0	212.8
2800	296.4	268.6	266.8	262.6	258.5	255.5	248.5	242.7	234.6	227.9	221.5
3000	305.9	276.9	275.0	270.6	266.4	263.2	256.0	249.9	241.5	234.5	227.8
3200	315.3	285.1	283.2	278.6	274.2	270.9	263.4	257.1	248.3	241.0	234.1
3400	324.5	293.2	291.2	286.4	281.9	278.5	270.6	264.1	255.0	247.5	240.3
3600	333.4	301.1	299.0	294.1	289.4	285.9	277.8	271.0	261.6	253.9	246.4
3800	342.0	308.8	306.7	301.6	296.8	293.1	284.8	277.9	268.2	260.2	252.6
4000	350.4	316.3	314.1	308.9	304.0	300.2	291.7	284.6	274.6	266.5	258.6
4200	358.5	323.6	321.4	316.0	311.0	307.1	298.4	291.1	281.0	272.6	264.5
4400	366.4	330.7	328.4	323.0	317.8	313.9	305.0	297.5	287.1	278.6	270.3
4600	374.1	337.7	335.3	329.8	324.5	320.5	311.4	303.8	293.1	284.4	276.0
4800	378.7	344.5	342.1	336.4	331.0	326.9	317.6	309.8	299.0	290.1	281.5
5000	378.7	351.0	348.6	342.8	337.3	333.1	323.7	315.8	304.7	295.6	286.9
5200	378.7	357.4	355.0	349.1	343.5	339.2	329.6	321.5	310.3	301.0	292.1
5400	378.7	363.7	361.1	355.2	349.5	345.1	335.3	327.1	315.7	306.3	297.2
5600	378.7	369.7	367.1	361.1	355.3	350.9	340.9	332.6	320.9	311.4	302.1
CLIMB LIMIT WT (1000 KG)	297.9	297.9	297.8	293.5	287.5	282.8	272.4	263.5	250.7	240.1	230.1

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.

With engine and wing anti-ice on, decrease field limit weight by 2200 kg and climb limit weight by 2100 kg.

Takeoff Field & Climb Limit Weights - Wet Runway**Flaps 15****8000 FT Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
2240	241.3	218.5	215.8	210.8	207.3	205.0	199.5	194.3	187.5	182.2	177.0
2400	249.7	226.1	223.3	218.1	214.4	212.1	206.3	201.0	194.0	188.5	183.1
2600	262.7	238.0	235.1	229.6	225.8	223.3	217.3	211.7	204.4	198.7	193.0
2800	273.5	247.7	244.7	239.0	235.0	232.5	226.2	220.4	212.7	206.7	200.9
3000	282.0	255.2	252.0	246.1	241.9	239.3	232.7	226.7	218.7	212.5	206.4
3200	290.4	262.5	259.2	253.1	248.8	246.0	239.2	232.9	224.6	218.1	211.7
3400	298.7	269.8	266.4	260.0	255.5	252.6	245.6	239.0	230.4	223.7	217.1
3600	306.8	276.9	273.4	266.8	262.1	259.2	251.9	245.1	236.2	229.3	222.5
3800	314.6	283.9	280.3	273.5	268.7	265.7	258.2	251.3	242.1	235.0	228.0
4000	322.3	290.8	287.1	280.1	275.2	272.1	264.4	257.3	247.9	240.6	233.4
4200	329.7	297.5	293.7	286.5	281.5	278.4	270.5	263.2	253.6	246.1	238.7
4400	337.0	304.0	300.1	292.8	287.7	284.5	276.4	269.0	259.1	251.4	243.9
4600	344.1	310.4	306.4	299.0	293.7	290.4	282.2	274.6	264.5	256.7	249.0
4800	351.0	316.6	312.5	304.9	299.6	296.2	287.8	280.1	269.8	261.8	254.0
5000	357.7	322.6	318.5	310.8	305.3	301.9	293.3	285.4	275.0	266.8	258.8
5200	364.2	328.5	324.3	316.4	310.9	307.4	298.6	290.6	280.0	271.7	263.5
5400	370.6	334.2	330.0	322.0	316.3	312.7	303.9	295.7	284.9	276.4	268.1
5600	376.7	339.8	335.5	327.3	321.6	317.9	308.9	300.6	289.6	281.0	272.6
CLIMB LIMIT WT (1000 KG)	273.7	273.7	270.5	262.7	256.7	253.2	243.8	234.7	222.5	213.2	204.0

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.

With engine and wing anti-ice on, decrease field limit weight by 2200 kg and climb limit weight by 2100 kg.

Takeoff Obstacle Limit Weight**Flaps 15**

Sea Level, 33°C & Below, Zero Wind

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or Auto

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	294.9	319.3	342.2	358.7							
20	274.3	297.3	315.6	330.9	344.4	355.8	362.6				
40	253.2	275.8	293.8	309.0	321.8	332.6	342.4	350.6	356.2	360.7	364.6
60	238.8	258.5	277.5	293.1	305.8	316.6	325.7	333.7	340.6	347.7	352.5
80	227.0	245.4	263.8	279.7	292.7	303.6	312.9	320.9	328.0	334.2	339.8
100	214.9	235.9	252.1	267.8	281.2	292.3	301.8	310.1	317.3	323.7	329.3
120	204.5	227.2	242.6	257.4	270.8	282.3	292.0	300.5	307.9	314.5	320.3
140	195.3	218.0	234.8	248.2	261.4	273.0	283.1	291.7	299.3	306.1	312.1
160		209.5	227.3	240.6	253.0	264.6	274.7	283.7	291.5	298.4	304.6
180		201.8	219.8	233.9	245.3	256.8	267.0	276.1	284.1	291.2	297.5
200		194.6	212.7	227.5	239.0	249.6	259.9	269.0	277.2	284.5	291.0
220			206.1	221.0	233.1	243.3	253.2	262.4	270.6	278.1	284.7
240			199.9	215.0	227.4	237.7	247.0	256.2	264.5	272.0	278.8
260			194.1	209.2	221.8	232.4	241.6	250.3	258.7	266.2	273.1
280				203.7	216.5	227.3	236.6	244.9	253.2	260.8	267.7
300				198.5	211.4	222.4	231.8	240.1	248.0	255.6	262.5

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustment

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)						
	160	200	240	280	320	360	400
33 & BELOW	0	0	0	0	0	0	0
34	-1.0	-1.3	-1.6	-1.8	-2.1	-2.4	-2.7
36	-3.9	-5.0	-6.0	-7.1	-8.2	-9.2	-10.3
38	-6.8	-8.7	-10.5	-12.4	-14.2	-16.1	-18.0
40	-9.7	-12.4	-15.0	-17.6	-20.3	-22.9	-25.6
42	-13.0	-16.4	-19.9	-23.4	-26.8	-30.3	-33.8
44	-16.2	-20.5	-24.8	-29.1	-33.3	-37.6	-41.9
46	-19.4	-24.5	-29.6	-34.8	-39.9	-45.0	-50.1
48	-22.7	-28.6	-34.5	-40.5	-46.4	-52.3	-58.2
50	-25.9	-32.7	-39.4	-46.2	-52.9	-59.7	-66.4

Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	160	200	240	280	320	360	400
S.L. & BELOW	0	0	0	0	0	0	0
1000	-6.8	-8.3	-9.8	-11.3	-12.9	-14.4	-15.9
2000	-13.5	-16.6	-19.6	-22.7	-25.7	-28.8	-31.8
3000	-19.3	-23.8	-28.3	-32.7	-37.2	-41.6	-46.1
4000	-25.2	-31.0	-36.9	-42.8	-48.6	-54.5	-60.4
5000	-31.2	-38.4	-45.6	-52.8	-60.0	-67.2	-74.5
6000	-37.2	-45.8	-54.3	-62.9	-71.4	-80.0	-88.6
7000	-43.6	-53.8	-64.1	-74.3	-84.5	-94.8	-105.0
8000	-50.0	-61.9	-73.8	-85.7	-97.6	-109.5	-121.4

Takeoff Obstacle Limit Weight**Flaps 15****Wind Adjustment**

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	160	200	240	280	320	360	400
15 TW	-34.2	-34.0	-33.7	-33.5	-33.2	-33.0	-32.7
10 TW	-22.8	-22.7	-22.5	-22.3	-22.2	-22.0	-21.8
5 TW	-11.4	-11.3	-11.2	-11.2	-11.1	-11.0	-10.9
0	0	0	0	0	0	0	0
10 HW	3.9	3.6	3.3	2.9	2.6	2.3	2.0
20 HW	7.9	7.2	6.5	5.9	5.2	4.6	3.9
30 HW	12.2	11.1	10.1	9.0	7.9	6.9	5.8
40 HW	16.5	15.0	13.6	12.1	10.6	9.2	7.7

With engine bleed for packs off, increase weight by 900 kg.

With engine and wing anti-ice on, decrease weight by 2500 kg.

Tire Speed Limit**Flaps 15**

AIRPORT OAT		TIRE SPEED LIMIT WEIGHT (1000 KG)				
		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	378.7	365.2	330.4	305.8	283.4
52	126	378.7	367.2	332.4	307.6	285.0
50	122	378.7	369.2	334.5	309.3	286.6
48	118	378.7	371.3	336.6	311.1	288.3
46	115	378.7	373.3	338.7	312.9	290.0
44	111	378.7	375.2	340.9	314.7	291.6
42	108	378.7	377.5	350.8	316.5	293.4
40	104	378.7	378.7	352.8	318.3	295.1
38	100	378.7	378.7	354.8	320.2	296.8
36	97	378.7	378.7	356.9	322.2	298.6
34	93	378.7	378.7	358.9	324.1	300.4
32	90	378.7	378.7	360.8	325.9	302.1
30	86	378.7	378.7	362.7	327.7	303.7
28	82	378.7	378.7	364.6	329.6	305.4
26	79	378.7	378.7	366.7	331.6	307.1
24	75	378.7	378.7	368.7	333.6	308.8
22	72	378.7	378.7	370.9	335.8	310.5
20	68	378.7	378.7	373.2	338.0	312.3
18	64	378.7	378.7	375.4	340.6	314.1
16	61	378.7	378.7	377.7	350.3	316.0
14	57	378.7	378.7	378.7	352.5	317.9
12	54	378.7	378.7	378.7	354.7	320.0
10	50	378.7	378.7	378.7	356.9	322.0
-40	-40	378.7	378.7	378.7	378.7	378.7

Increase tire speed limit weight by 2450 kg per knot headwind.

Decrease tire speed limit weight by 5600 kg per knot tailwind.

Takeoff Speeds - Dry Runway

Flaps 15

V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	KIAS		
	V1	VR	V2
360	167	174	178
340	164	170	176
320	158	165	171
300	152	158	166
280	146	152	161
260	138	145	156
240	130	138	151
220	122	131	145
200	113	123	139
180	103	114	132
160	93	105	125
140	82	96	118

Check V1(MCG), Minimum V2, and Minimum Takeoff Weight.

V1, VR, V2 Adjustments*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
°C	°F	-2	0	2	4	6	8	-2	0	2	4	6	8	-2	0	2	4	6	8
70	158	12	15					6	7					-2	-3				
60	140	8	10	13	15			4	5	7	8			-2	-2	-2	-3		
50	122	4	6	8	11	14	17	2	3	5	6	7	9	-1	-1	-2	-2	-2	-3
40	104	1	2	5	7	10	14	1	1	3	4	6	8	0	-1	-1	-1	-2	-2
30	86	0	0	2	4	7	11	0	0	1	3	4	6	0	0	0	-1	-1	-2
20	68	0	0	1	3	5	9	0	0	1	2	3	5	0	0	0	-1	-1	-2
-60	-76	0	0	1	3	5	8	0	0	1	2	3	4	0	0	0	-1	-1	-1

Slope and Wind V1 Adjustments*

WEIGHT (1000 KG)	SLOPE (%)						WIND (KTS)							
	-2	-1	0	1	2		-15	-10	-5	0	10	20	30	40
360	-4	-2	0	3	6		-3	-2	0	0	1	2	3	4
340	-4	-1	0	3	5		-3	-2	0	0	1	2	3	3
320	-3	-1	0	3	5		-2	-1	0	0	1	2	3	3
300	-3	-1	0	3	4		-2	-1	0	0	1	2	3	3
280	-3	-1	0	3	4		-2	-1	0	0	1	2	2	3
260	-2	-1	0	2	4		-2	-1	0	0	1	2	2	3
240	-2	0	0	2	4		-1	-1	0	0	1	2	3	3
220	-2	0	0	2	4		-1	0	0	0	1	2	3	3
200	-2	0	0	3	4		-1	0	0	0	1	2	3	3
180	-1	0	0	3	4		-1	0	1	0	1	3	3	4
160	-1	0	0	3	4		-1	0	1	0	1	3	3	4
140	-1	0	0	3	4		-1	0	1	0	1	3	4	4

*V1 not to exceed VR

Takeoff Speeds - Dry Runway

Flaps 15

V1(MCG)

Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
60	140	125	121	119	117		
50	122	128	125	119	117	115	110
40	104	136	133	127	122	116	110
30	86	138	137	133	127	122	115
20	68	138	138	134	130	126	119
-60	-76	140	139	135	131	127	121

Minimum V2

Max Takeoff Thrust

PRESSURE ALTITUDE (FT)	-2000	0	2000	4000	6000	8000
SPEED (KIAS)	135	133	131	128	126	123

Takeoff Speeds - Wet Runway

Flaps 15

V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	KIAS		
	V1	VR	V2
360	159	174	178
340	155	170	176
320	148	165	171
300	141	158	166
280	134	152	161
260	126	145	156
240	118	138	151
220	110	131	145
200	100	123	139
180	92	114	132
160	81	105	125
140	71	96	118

Check V1(MCG), Minimum V2, and Minimum Takeoff Weight.

V1, VR, V2 Adjustment*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
°C	°F	-2	0	2	4	6	8	-2	0	2	4	6	8	-2	0	2	4	6	8
70	158	14	17					6	7					-2	-3				
60	140	9	11	14	16			4	5	7	8			-2	-2	-2	-3		
50	122	5	7	9	12	14	18	2	3	5	6	7	9	-1	-1	-2	-2	-2	-3
40	104	1	2	5	8	11	15	1	1	3	4	6	8	0	-1	-1	-1	-2	-2
30	86	0	0	2	5	8	12	0	0	1	3	4	6	0	0	0	-1	-1	-2
20	68	0	0	1	3	6	9	0	0	1	2	3	5	0	0	0	-1	-1	-2
-60	-76	0	0	1	3	5	8	0	0	1	2	3	4	0	0	0	-1	-1	-1

Slope and Wind V1 Adjustment*

WEIGHT (1000 KG)	SLOPE (%)						WIND (KTS)							
	-2	-1	0	1	2		-15	-10	-5	0	10	20	30	40
360	-6	-3	0	3	6		-4	-3	-1	0	1	2	3	4
340	-6	-3	0	3	6		-4	-3	-1	0	1	2	3	4
320	-6	-3	0	3	6		-5	-3	-1	0	1	2	3	4
300	-5	-3	0	3	5		-5	-3	-1	0	1	2	3	4
280	-5	-2	0	3	5		-5	-3	-1	0	1	2	3	4
260	-4	-2	0	3	5		-5	-3	-1	0	1	3	4	5
240	-4	-2	0	3	5		-5	-3	-1	0	1	3	4	5
220	-3	-1	0	3	5		-4	-2	-1	0	2	3	4	5
200	-3	-1	0	3	5		-4	-2	0	0	2	4	5	6
180	-2	0	0	4	6		-3	-1	0	0	2	4	5	6
160	-1	1	0	4	6		-2	-1	1	0	2	5	6	7
140	0	2	0	5	6		-2	0	2	0	3	5	6	7

*V1 not to exceed VR

Takeoff Speeds - Wet Runway

Flaps 15

V1(MCG)

Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
60	140	125	121	119	117		
50	122	128	125	119	117	115	110
40	104	136	133	127	122	116	110
30	86	138	137	133	127	122	115
20	68	138	138	134	130	126	119
-60	-76	140	139	135	131	127	121

Minimum V2

Max Takeoff Thrust

PRESSURE ALTITUDE (FT)	-2000	0	2000	4000	6000	8000
SPEED (KIAS)	135	133	131	128	126	123

Intentionally
Blank

Performance Dispatch**Chapter PD****Enroute****Section 31****Long Range Cruise Maximum Operating Altitude****Max Climb Thrust****ISA + 10°C and Below**

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27300	5	30400	28800	27200
350	27900	4	31000	29400	27800
340	28500	3	31700	30000	28500
330	29200	1	32200	30500	29000
320	29900	0	32700	31000	29500
310	30600	-2	33200	31600	30000
300	31300	-4	33700	32100	30600
290	32000	-5	34300	32700	31200
280	32800	-7	34900	33300	31800
270	33600	-9	35500	33900	32400
260	34400	-11	36100	34500	33100
250	35200	-12	36800	35200	33800
240	36000	-14	37500	35900	34500
230	36900	-15	38200	36600	35200
220	37800	-15	39000	37400	36000
210	38800	-15	39800	38200	36800
200	39800	-15	40600	39000	37700
190	40900	-15	41500	39900	38600
180	42000	-15	42500	40900	39600
170	43100	-15	43100	42100	40800
160	43100	-15	43100	43100	42000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27300	11	30400	28800	27200
350	27900	10	31000	29400	27800
340	28500	8	31700	30000	28500
330	29200	7	32200	30500	29000
320	29900	5	32700	31000	29500
310	30600	4	33200	31600	30000
300	31300	2	33700	32100	30600
290	32000	0	34300	32700	31200
280	32800	-1	34900	33300	31800
270	33600	-3	35500	33900	32400
260	34400	-5	36100	34500	33100
250	35200	-7	36800	35200	33800
240	36000	-9	37500	35900	34500
230	36900	-9	38200	36600	35200
220	37800	-9	39000	37400	36000
210	38800	-9	39800	38200	36800
200	39800	-9	40600	39000	37700
190	40900	-9	41500	39900	38600
180	42000	-9	42500	40900	39600
170	43100	-9	43100	42100	40800
160	43100	-9	43100	43100	42000

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27300	17	30400	28800	27200
350	27900	15	31000	29400	27800
340	28500	14	31700	30000	28500
330	29200	12	32200	30500	29000
320	29900	11	32700	31000	29500
310	30600	9	33200	31600	30000
300	31300	8	33700	32100	30600
290	32000	6	34300	32700	31200
280	32800	4	34900	33300	31800
270	33600	3	35500	33900	32400
260	34400	1	36100	34500	33100
250	35200	-1	36800	35200	33800
240	36000	-3	37500	35900	34500
230	36900	-3	38200	36600	35200
220	37800	-3	39000	37400	36000
210	38800	-3	39800	38200	36800
200	39800	-3	40600	39000	37700
190	40900	-3	41500	39900	38600
180	42000	-3	42500	40900	39600
170	43100	-3	43100	42100	40800
160	43100	-3	43100	43100	42000

Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
665	625	588	556	526	500	479	458	440	423	407
1320	1242	1171	1108	1052	1000	958	919	883	850	820
1973	1857	1752	1660	1576	1500	1438	1381	1327	1278	1233
2623	2471	2333	2211	2101	2000	1918	1842	1771	1706	1647
3271	3083	2913	2761	2625	2500	2398	2304	2216	2135	2061
3915	3693	3491	3311	3149	3000	2879	2766	2661	2564	2475
4556	4301	4068	3860	3672	3500	3359	3228	3106	2993	2890
5195	4906	4643	4407	4195	4000	3840	3690	3551	3422	3304
5831	5510	5216	4954	4717	4500	4320	4152	3995	3851	3719
6465	6112	5788	5500	5240	5000	4800	4613	4440	4280	4133
7096	6712	6360	6046	5762	5500	5280	5075	4885	4709	4547
7726	7311	6931	6591	6283	6000	5761	5537	5329	5137	4961
8354	7909	7501	7136	6805	6500	6240	5998	5773	5565	5375
8981	8506	8070	7680	7326	7000	6720	6460	6217	5993	5788
9607	9102	8639	8224	7847	7500	7201	6921	6661	6421	6201
10233	9698	9208	8768	8368	8000	7681	7382	7105	6849	6614
10858	10294	9777	9312	8890	8500	8161	7844	7549	7277	7028
11483	10890	10345	9856	9411	9000	8641	8305	7993	7705	7441
12108	11486	10914	10399	9932	9500	9121	8766	8437	8133	7854
12732	12081	11482	10943	10453	10000	9601	9228	8881	8561	8267

Reference Fuel and Time Required

AIR DIST(NM)	PRESSURE ALTITUDE (1000 FT)									
	27		29		31		33		35	
	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)
500	8.6	1:19	8.4	1:18	8.4	1:17	8.3	1:15	8.2	1:14
1000	15.8	2:30	15.5	2:28	15.2	2:24	14.9	2:20	14.6	2:17
1500	23.2	3:40	22.7	3:36	22.2	3:29	21.8	3:23	21.3	3:20
2000	30.7	4:50	29.9	4:43	29.3	4:34	28.6	4:27	27.9	4:23
2500	38.4	5:58	37.4	5:49	36.6	5:38	35.7	5:29	34.9	5:25
3000	46.1	7:06	45.0	6:55	43.9	6:42	42.8	6:32	41.8	6:27
3500	54.2	8:11	52.8	7:58	51.5	7:44	50.2	7:34	49.1	7:29
4000	62.3	9:17	60.6	9:02	59.1	8:47	57.6	8:36	56.4	8:31
4500	70.7	10:21	68.8	10:04	67.0	9:48	65.3	9:38	64.0	9:34
5000	79.1	11:25	76.9	11:07	74.9	10:50	73.1	10:39	71.7	10:36
5500	87.8	12:27	85.4	12:08	83.1	11:51	81.2	11:41	79.9	11:38
6000	96.6	13:29	93.8	13:10	91.3	12:53	89.3	12:42	88.1	12:40
6500	105.7	14:30	102.7	14:11	100.0	13:54	97.9	13:44	97.0	13:43
7000	114.8	15:32	111.5	15:11	108.6	14:55	106.5	14:46	105.8	14:46
7500	124.3	16:32	120.7	16:12	117.8	15:56	115.8	15:48	115.6	15:49
8000	133.8	17:33	130.0	17:13	126.9	16:57	125.1	16:50	125.3	16:52
8500	143.9	18:33	139.8	18:13	136.7	17:58	135.3	17:52		
9000	153.9	19:33	149.7	19:14	146.5	19:00	145.5	18:54		
9500	164.4	20:33	160.1	20:15	157.2	20:01	156.8	19:57		
10000	175.0	21:33	170.5	21:15	167.9	21:03	168.0	21:00		

**Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	160	180	200	220	240
20	-2.1	-1.1	0.0	1.2	2.7
30	-3.1	-1.6	0.0	1.9	4.3
40	-4.2	-2.1	0.0	2.7	6.2
50	-5.3	-2.7	0.0	3.6	8.3
60	-6.4	-3.2	0.0	4.7	10.7
70	-7.5	-3.8	0.0	5.9	13.4
80	-8.7	-4.4	0.0	7.2	16.3
90	-9.8	-5.0	0.0	8.6	19.5
100	-11.0	-5.6	0.0	10.2	23.0
110	-12.2	-6.2	0.0	11.9	26.7
120	-13.4	-6.8	0.0	13.7	30.7
130	-14.6	-7.5	0.0	15.7	35.0
140	-15.9	-8.1	0.0	17.8	39.5
150	-17.1	-8.8	0.0	20.0	44.3
160	-18.4	-9.5	0.0	22.3	49.4
170	-19.7	-10.2	0.0	24.8	54.7
180	-21.0	-10.9	0.0	27.3	60.3

Based on 310/.84 climb, Long Range Cruise and .84/310/250 descent.

**Long Range Cruise Step Climb Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1292	1221	1157	1099	1047	1000	957	917	881	847	816
1923	1820	1728	1645	1569	1500	1437	1379	1325	1276	1229
2554	2420	2299	2190	2091	2000	1917	1840	1770	1704	1643
3185	3020	2871	2735	2612	2500	2397	2302	2214	2133	2057
3816	3619	3442	3281	3134	3000	2877	2764	2659	2562	2472
4446	4218	4012	3826	3656	3500	3357	3225	3104	2991	2886
5077	4817	4583	4371	4177	4000	3837	3687	3548	3420	3300
5707	5416	5154	4916	4699	4500	4317	4149	3993	3849	3715
6336	6015	5724	5461	5220	5000	4798	4611	4438	4278	4129
6966	6613	6295	6006	5742	5500	5278	5073	4883	4707	4544
7595	7212	6865	6550	6263	6000	5758	5535	5329	5137	4959
8224	7810	7435	7095	6784	6500	6238	5997	5774	5566	5373
8853	8408	8005	7640	7306	7000	6719	6459	6219	5996	5788
9481	9006	8575	8184	7827	7500	7199	6921	6664	6426	6204
10110	9603	9145	8729	8348	8000	7679	7384	7110	6855	6619
10738	10201	9715	9273	8870	8500	8160	7846	7555	7285	7034
11366	10798	10284	9817	9391	9000	8640	8308	8001	7715	7449
11993	11395	10854	10362	9912	9500	9121	8771	8446	8145	7865
12621	11992	11423	10906	10433	10000	9601	9233	8892	8575	8280

Trip Fuel and Time Required

AIR DIST (NM)	TRIP FUEL (1000 KG)									TIME (HRS:MIN)
	LANDING WEIGHT (1000 KG)									
	150	160	170	180	190	200	210	220	230	
1000	11.8	12.2	12.7	13.3	13.8	14.5	14.9	15.5	16.0	2:16
1500	16.9	17.6	18.3	19.1	20.0	20.9	21.6	22.4	23.3	3:18
2000	22.1	23.0	24.1	25.2	26.4	27.5	28.5	29.6	30.9	4:20
2500	27.4	28.6	29.9	31.4	32.9	34.3	35.6	37.1	38.6	5:23
3000	32.9	34.4	36.0	37.8	39.5	41.3	42.9	44.7	46.5	6:25
3500	38.5	40.3	42.3	44.3	46.4	48.4	50.4	52.5	54.6	7:27
4000	44.2	46.3	48.7	51.0	53.4	55.8	58.1	60.5	63.0	8:29
4500	50.1	52.6	55.2	57.9	60.6	63.4	66.0	68.8	71.5	9:31
5000	56.2	59.0	61.9	64.9	68.1	71.2	74.1	77.2	80.3	10:33
5500	62.5	65.6	68.8	72.2	75.7	79.2	82.5	85.9	89.4	11:34
6000	68.9	72.3	75.9	79.7	83.6	87.4	91.0	94.8	98.8	12:36
6500	75.4	79.2	83.2	87.4	91.6	95.8	99.8	104.1	108.5	13:38
7000	82.1	86.3	90.8	95.3	99.9	104.4	108.9	113.6	118.4	14:39
7500	89.0	93.6	98.5	103.4	108.3	113.3	118.2	123.4	128.6	15:40
8000	96.1	101.2	106.4	111.7	117.0	122.5	127.9	133.4	139.0	16:42
8500	103.4	108.9	114.5	120.2	126.1	132.0	137.8	143.8	149.8	17:43
9000	111.0	116.8	122.8	129.0	135.3	141.7	148.0	154.4	160.9	18:44
9500	118.7	124.9	131.4	138.0	144.9	151.7	158.4	165.3	172.2	19:45
10000	126.6	133.3	140.2	147.4	154.7	162.0	169.2	176.5	183.9	20:46

Based on 310/.84 climb, Long Range Cruise and .84/310/250 descent.

Valid for all pressure altitudes with 4000 ft step climb to 2000 ft above optimum altitude.

Short Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
95	81	70	62	55	50	46	42	39	36	34
161	143	129	118	108	100	93	87	82	77	73
225	205	187	173	161	150	141	132	125	118	113
288	264	245	228	213	200	189	178	169	161	153
349	323	301	282	265	250	237	225	214	204	195
410	382	357	336	317	300	285	271	258	247	237
471	440	414	390	369	350	333	317	303	290	279
532	499	470	444	421	400	381	364	348	334	320
595	559	527	499	473	450	429	410	393	376	362
660	621	585	554	526	500	477	456	436	419	402

Trip Fuel and Time

AIR DIST (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		160	180	200	220	240	
50	FUEL (1000 KG)	1.6	1.8	1.9	2.0	2.1	0:14
	ALT (FT)	11000	9000	9000	7000	5000	
100	FUEL (1000 KG)	2.4	2.6	2.7	2.8	3.0	0:23
	ALT (FT)	15000	13000	13000	13000	13000	
150	FUEL (1000 KG)	3.2	3.4	3.5	3.7	3.9	0:30
	ALT (FT)	21000	21000	21000	21000	21000	
200	FUEL (1000 KG)	3.8	4.1	4.3	4.5	4.8	0:37
	ALT (FT)	27000	27000	27000	25000	25000	
250	FUEL (1000 KG)	4.4	4.7	5.0	5.3	5.6	0:43
	ALT (FT)	37000	31000	29000	29000	29000	
300	FUEL (1000 KG)	5.0	5.3	5.6	6.0	6.3	0:48
	ALT (FT)	41000	39000	37000	35000	33000	
350	FUEL (1000 KG)	5.5	5.9	6.2	6.6	7.0	0:54
	ALT (FT)	43000	39000	37000	35000	35000	
400	FUEL (1000 KG)	6.0	6.4	6.9	7.3	7.8	1:00
	ALT (FT)	43000	39000	37000	37000	35000	
450	FUEL (1000 KG)	6.5	7.0	7.5	8.0	8.5	1:06
	ALT (FT)	43000	41000	39000	37000	35000	
500	FUEL (1000 KG)	7.0	7.6	8.1	8.7	9.2	1:13
	ALT (FT)	43000	41000	39000	37000	35000	

Holding Planning**Flaps Up**

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)									
	PRESSURE ALTITUDE (FT)									
	1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
360	9310	9240	9140	9180	9690	10040	10600			
340	8810	8730	8620	8620	9080	9360	9780			
320	8250	8160	8050	8030	8430	8630	8950	9950		
300	7720	7630	7510	7480	7600	7980	8260	8850		
280	7250	7150	7030	6970	7000	7380	7620	8060		
260	6790	6670	6530	6470	6470	6800	6990	7250	8510	
240	6350	6220	6060	5980	5970	6030	6380	6590	7270	
220	5940	5790	5610	5530	5490	5490	5770	5960	6450	7070
200	5590	5430	5230	5140	5070	5040	5150	5350	5660	6020
180	5270	5100	4900	4800	4710	4760	4650	4750	5000	5210
160	5120	4940	4750	4610	4500	4440	4330	4310	4460	4560

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
360	10290	10260	10210	10300	10530
340	9680	9630	9570	9620	9830
320	9080	9030	8960	8980	9160
300	8510	8450	8370	8380	8520
280	7940	7870	7770	7770	7860
260	7390	7300	7190	7190	7240
240	6860	6740	6630	6600	6620
220	6340	6200	6070	6010	6020
200	5880	5720	5550	5470	5430
180	5480	5300	5110	5020	4960
160	5260	5080	4860	4760	4660

These tables include 5% additional fuel for holding in a racetrack pattern.

Crew Oxygen Requirements**Required Pressure (PSI) for Two 114/115 Cubic Ft. Cylinder**

BOTTLE TEMPERATURE		NUMBER OF CREW USING OXYGEN		
°C	°F	2	3	4
50	122	325	435	545
45	113	320	430	540
40	104	315	420	530
35	95	310	415	520
30	86	305	410	510
25	77	300	400	505
20	68	295	395	495
15	59	290	390	485
10	50	285	380	480
5	41	280	375	470
0	32	275	370	460
-5	23	270	360	455
-10	14	265	355	445

For more extensive than normal crew usage, add 0.6 psi/person/minute.

ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
32	166.0	164.5	161.0
30	183.7	181.5	175.5
28	197.9	193.2	185.8
26	213.1	207.2	199.2
24	229.4	222.1	213.9
22	246.8	238.7	230.1
20	271.4	264.3	254.0
18	293.8	284.5	273.3
16	318.2	306.9	294.9
14	339.7	326.4	313.5
12	361.3	347.4	334.2

Anti-Ice Adjustments

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG)									
	PRESSURE ALTITUDE (1000 FT)									
	14	16	18	20	22	24	26	28	30	
ENGINE ONLY	-0.7	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINE AND WING	-2.7	-2.0	-1.6	-1.2	-1.3	-1.4	-1.5	-1.5	-1.5	-1.5

ALL ENGINES**Decompression Critical Fuel Reserves - LRC Cruise
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEAD WIND COMPONENT (KTS)						TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
283	261	243	227	212	200	189	179	170	162	155
567	523	486	453	425	400	378	358	340	324	309
851	785	729	680	638	600	567	537	510	486	463
1134	1047	972	907	850	800	755	716	680	647	618
1418	1309	1215	1134	1063	1000	944	895	850	809	772
1702	1570	1458	1360	1275	1200	1133	1073	1020	971	927
1985	1832	1701	1587	1488	1400	1322	1252	1190	1133	1081
2269	2094	1944	1814	1700	1600	1511	1431	1360	1295	1236
2553	2356	2187	2041	1913	1800	1700	1610	1529	1456	1390
2836	2617	2430	2267	2125	2000	1889	1789	1699	1618	1545
3120	2879	2673	2494	2338	2200	2077	1968	1869	1780	1699
3404	3141	2916	2721	2550	2400	2266	2147	2039	1942	1853
3687	3403	3159	2948	2763	2600	2455	2326	2209	2104	2008
3971	3665	3402	3174	2976	2800	2644	2505	2379	2266	2162
4255	3926	3645	3401	3188	3000	2833	2683	2549	2427	2317

Critical Fuel (1000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)										
	160	180	200	220	240	260	280	300	320	340	360
200	4.2	4.3	4.5	4.7	4.9	5.1	5.3	5.5	5.7	6.0	6.2
400	7.6	7.9	8.1	8.5	8.9	9.3	9.6	9.9	10.3	10.7	11.1
600	11.0	11.4	11.8	12.3	12.8	13.3	13.8	14.3	14.8	15.4	16.0
800	14.4	14.9	15.4	16.1	16.7	17.4	18.0	18.6	19.3	20.0	20.8
1000	17.8	18.4	19.1	19.8	20.6	21.4	22.2	22.9	23.7	24.6	25.6
1200	21.1	21.9	22.7	23.6	24.5	25.4	26.4	27.2	28.1	29.2	30.3
1400	24.5	25.3	26.2	27.2	28.3	29.4	30.5	31.5	32.6	33.8	35.1
1600	27.8	28.7	29.7	30.9	32.1	33.3	34.5	35.7	36.9	38.2	39.7
1800	31.1	32.1	33.2	34.5	35.9	37.2	38.5	39.9	41.2	42.6	44.3
2000	34.5	35.5	36.8	38.2	39.6	41.1	42.6	44.0	45.5	47.1	48.8
2200	37.8	38.8	40.2	41.8	43.4	45.0	46.6	48.2	49.8	51.5	53.4
2400	41.1	42.2	43.6	45.3	47.0	48.8	50.5	52.3	54.0	55.8	57.9
2600	44.5	45.5	47.0	48.8	50.7	52.6	54.4	56.3	58.2	60.1	62.3
2800	47.8	48.8	50.4	52.3	54.3	56.3	58.4	60.3	62.3	64.5	66.7
3000	51.1	52.1	53.8	55.9	58.0	60.1	62.3	64.4	66.5	68.8	71.2

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included.

Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required 0.8% per 10°C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (3%) for the total forecast time or engine and wing anti-ice on and ice drag (7%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engine cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

ENGINE INOP

**Decompression Critical Fuel Reserves - LRC Cruise
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEAD WIND COMPONENT (KTS)						TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
286	263	244	227	213	200	189	179	169	161	154
572	527	488	455	426	400	377	357	339	322	308
858	790	732	682	638	600	566	536	508	484	461
1145	1054	976	910	851	800	755	714	678	645	615
1431	1317	1221	1137	1064	1000	943	892	847	806	769
1717	1581	1465	1364	1277	1200	1132	1071	1016	967	922
2003	1844	1709	1592	1490	1400	1320	1249	1186	1128	1076
2290	2108	1953	1819	1703	1600	1509	1428	1355	1289	1230
2576	2372	2197	2047	1915	1800	1698	1606	1524	1450	1383
2862	2635	2441	2274	2128	2000	1886	1785	1694	1612	1537
3149	2899	2685	2501	2341	2200	2075	1963	1863	1773	1691
3435	3162	2930	2729	2554	2400	2264	2142	2033	1934	1844
3721	3426	3174	2956	2767	2600	2452	2320	2202	2095	1998
4007	3689	3418	3184	2980	2800	2641	2499	2371	2256	2152
4294	3953	3662	3411	3192	3000	2829	2677	2541	2417	2305

Critical Fuel (1000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)										
	160	180	200	220	240	260	280	300	320	340	360
200	4.0	4.1	4.4	4.7	4.9	5.1	5.4	5.6	5.8	6.1	6.4
400	7.2	7.6	8.0	8.4	8.9	9.4	9.8	10.2	10.7	11.1	11.6
600	10.5	11.0	11.6	12.2	12.9	13.5	14.1	14.8	15.4	16.2	16.8
800	13.8	14.5	15.2	16.0	16.8	17.6	18.4	19.3	20.1	21.0	21.9
1000	17.0	17.9	18.8	19.8	20.8	21.8	22.7	23.7	24.7	25.8	26.9
1200	20.1	21.2	22.3	23.5	24.7	25.9	27.0	28.2	29.4	30.6	31.9
1400	23.2	24.5	25.7	27.1	28.5	29.9	31.2	32.6	33.9	35.4	36.9
1600	26.3	27.7	29.2	30.7	32.3	33.8	35.3	36.9	38.4	40.1	41.8
1800	29.4	31.0	32.6	34.3	36.0	37.8	39.5	41.2	42.9	44.7	46.6
2000	32.5	34.3	36.1	37.9	39.8	41.7	43.6	45.5	47.4	49.3	51.4
2200	35.6	37.5	39.4	41.5	43.5	45.6	47.7	49.7	51.8	53.9	56.2
2400	38.7	40.6	42.7	44.9	47.2	49.4	51.6	53.8	56.1	58.4	60.8
2600	41.8	43.7	46.0	48.4	50.8	53.2	55.6	57.9	60.4	62.9	65.4
2800	44.9	46.8	49.2	51.8	54.4	57.0	59.5	62.1	64.7	67.3	70.1
3000	48.0	49.9	52.5	55.2	58.0	60.7	63.5	66.2	68.9	71.7	74.6

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

- Adjustments:
- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
 - Increase fuel required 0.8% per 10°C above ISA.
 - When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (9%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

ENGINE INOP**Driftdown Critical Fuel Reserves - LRC Driftdown/Cruise
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
264	248	234	221	210	200	190	182	174	167	160
531	498	469	444	420	400	381	363	348	333	320
800	750	706	666	631	600	571	545	521	499	479
1072	1003	943	890	842	800	761	726	694	665	638
1344	1257	1181	1114	1054	1000	951	906	866	829	795
1618	1513	1420	1338	1265	1200	1140	1087	1038	994	953
1894	1769	1659	1563	1477	1400	1330	1267	1210	1158	1110
2170	2026	1899	1788	1688	1600	1520	1447	1382	1321	1266
2447	2283	2139	2013	1900	1800	1709	1627	1553	1485	1423
2725	2541	2380	2238	2112	2000	1898	1807	1724	1648	1579
3003	2799	2620	2463	2324	2200	2088	1987	1895	1812	1735
3281	3056	2861	2688	2536	2400	2277	2167	2066	1975	1891
3559	3314	3101	2914	2748	2600	2467	2346	2238	2138	2047
3836	3572	3341	3139	2959	2800	2656	2526	2409	2302	2204
4113	3829	3581	3364	3171	3000	2845	2706	2580	2465	2360

Critical Fuel (1000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)										
	160	180	200	220	240	260	280	300	320	340	360
200	4.6	4.8	5.1	5.3	5.5	5.6	5.8	6.1	6.3	6.5	6.8
400	7.1	7.6	8.1	8.6	9.1	9.5	10.0	10.4	11.0	11.5	12.2
600	9.5	10.2	11.1	11.8	12.5	13.2	13.9	14.6	15.4	16.3	17.3
800	11.9	12.9	13.9	15.0	15.9	16.8	17.8	18.7	19.8	21.1	22.3
1000	14.2	15.4	16.8	18.1	19.2	20.4	21.6	22.8	24.2	25.7	27.3
1200	16.5	18.0	19.6	21.1	22.5	24.0	25.4	26.9	28.5	30.3	32.2
1400	18.7	20.5	22.3	24.1	25.8	27.5	29.2	30.9	32.7	34.8	37.1
1600	21.0	23.0	25.0	27.1	29.0	31.0	32.9	34.8	36.9	39.3	41.8
1800	23.1	25.4	27.7	30.0	32.1	34.4	36.6	38.7	41.0	43.7	46.5
2000	25.3	27.8	30.4	32.9	35.3	37.8	40.2	42.6	45.1	48.0	51.1
2200	27.5	30.2	33.0	35.7	38.4	41.1	43.8	46.4	49.2	52.3	55.7
2400	29.6	32.6	35.6	38.5	41.5	44.4	47.3	50.2	53.2	56.6	60.2
2600	31.7	34.9	38.1	41.3	44.5	47.7	50.8	53.9	57.1	60.8	64.6
2800	33.8	37.2	40.7	44.1	47.5	51.0	54.3	57.6	61.1	65.0	69.0
3000	35.8	39.5	43.2	46.8	50.4	54.2	57.7	61.3	64.9	69.1	73.4

Based on: Driftdown to and cruise at level off altitude, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required 0.8% per 10°C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (12%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

Intentionally
Blank

Performance Dispatch**Chapter PD****Landing****Section 32****Landing Field Limit Weight - Dry Runway****Flaps 30****Wind Corrected Field Length (M)**

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1400	1160	1210	1320	1400	1450	1530	1600	1690
1600	1300	1380	1500	1600	1660	1760	1850	1960
1800	1440	1540	1670	1800	1880	1990	2090	2220
2000	1590	1700	1850	2000	2090	2220	2340	2480
2200	1730	1860	2030	2200	2310	2450	2590	2740
2400	1880	2020	2200	2400	2520	2670	2830	3000
2600	2020	2190	2380	2600	2740	2900	3080	3260
2800	2170	2350	2560	2800	2960	3130	3330	3530
3000	2310	2510	2730	3000	3170	3360	3570	3790
3200	2450	2670	2910	3200	3390	3590	3820	4050
3400	2600	2830	3080	3400	3600	3820	4060	4310
3600	2740	3000	3260	3600	3820	4050	4310	4570
3800	2890	3160	3440	3800	4030	4280	4560	4830
4000	3030	3320	3610	4000	4250	4510	4800	5100
4200	3180	3480	3790	4200	4460	4740	5050	5360
4400	3320	3640	3960	4400	4680	4960	5290	5620

Field Limit Weight (1000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1400	188.7	176.8	166.1	155.9	
1600	227.3	213.3	200.0	187.5	175.6
1800	263.8	249.9	234.4	219.5	205.4
2000	293.0	277.5	265.6	252.5	236.4
2200	309.3	301.2	292.7	276.4	264.6
2400	322.0	313.1	305.0	296.9	287.0
2600	334.7	324.6	315.2	307.0	298.7
2800	347.9	336.1	325.8	316.1	307.8
3000	360.6	348.5	336.3	325.9	316.1
3200	372.1	359.6	347.0	335.3	324.9
3400	383.1	369.9	357.6	344.9	333.5
3600		379.7	366.7	354.7	341.7
3800			375.4	362.8	351.2
4000			384.0	370.5	358.4
4200				377.8	365.3
4400				385.0	371.8

With manual speedbrakes, decrease weight by 21450 kg.

With 1 brake deactivated, decrease weight by 20600 kg.

With 2 brakes deactivated, decrease weight by 41900 kg.

Landing Field Limit Weight - Wet Runway

Flaps 30

Wind Corrected Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1400	1180	1230	1340	1400	1440	1520	1580	1670
1600	1320	1390	1510	1600	1650	1750	1830	1930
1800	1470	1550	1690	1800	1870	1980	2080	2200
2000	1610	1710	1860	2000	2080	2200	2320	2460
2200	1750	1870	2040	2200	2300	2430	2570	2720
2400	1900	2040	2220	2400	2510	2660	2820	2980
2600	2040	2200	2390	2600	2730	2890	3060	3240
2800	2190	2360	2570	2800	2950	3120	3310	3500
3000	2330	2520	2740	3000	3160	3350	3550	3770
3200	2480	2680	2920	3200	3380	3580	3800	4030
3400	2620	2850	3100	3400	3590	3810	4050	4290
3600	2760	3010	3270	3600	3810	4040	4290	4550
3800	2910	3170	3450	3800	4020	4270	4540	4810
4000	3050	3330	3630	4000	4240	4500	4780	5070
4200	3200	3490	3800	4200	4450	4720	5030	5340
4400	3340	3660	3980	4400	4670	4950	5280	5600

Field Limit Weight (1000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1400	153.4				
1600	187.0	175.2	164.6	154.6	
1800	220.6	206.9	194.1	182.0	170.4
2000	253.4	238.7	223.8	209.7	196.3
2200	278.4	266.6	253.6	238.1	222.9
2400	300.4	291.1	275.9	263.7	250.0
2600	313.2	305.1	296.8	285.0	270.5
2800	324.2	315.0	306.8	298.7	289.3
3000	335.2	325.1	315.7	307.4	299.1
3200	346.6	335.1	324.9	315.4	307.0
3400	357.9	345.5	334.0	323.8	314.3
3600	368.1	355.8	343.0	332.1	321.8
3800	377.9	365.0	353.0	340.1	329.4
4000	387.4	373.7	361.2	349.2	336.7
4200		382.3	369.0	356.8	344.1
4400			376.5	363.8	352.1

With manual speedbrakes, decrease weight by 21450 kg.

With 1 brake deactivated, decrease weight by 20600 kg.

With 2 brakes deactivated, decrease weight by 41900 kg.

Landing Climb Limit Weight**Valid for approach with flaps 20 and landing with flaps 30**

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
54	129	297.3	279.1				
52	126	306.3	287.0				
50	122	315.2	294.5	269.7			
48	118	323.5	303.4	276.9			
46	115	331.8	312.4	284.1	259.6		
44	111	340.4	321.1	291.5	267.7		
42	108	352.1	329.0	299.1	275.0	251.6	
40	104	359.1	337.3	307.2	281.4	257.0	
38	100	366.2	349.6	316.0	287.8	262.8	233.8
36	97	369.0	356.4	323.2	293.4	269.2	238.4
34	93	369.3	363.2	330.4	299.7	274.4	243.0
32	90	369.5	365.7	338.2	306.4	278.7	247.1
30	86	369.8	365.9	346.1	312.9	282.9	250.9
28	82	370.1	366.0	352.5	318.7	287.3	254.6
26	79	370.3	366.1	352.7	322.6	292.2	258.2
24	75	370.6	366.3	352.8	326.0	297.0	263.1
22	72	370.8	366.4	352.9	327.4	300.3	268.1
20	68	371.1	366.5	352.9	327.5	302.5	272.4
18	64	371.3	366.7	353.0	327.6	304.7	275.2
16	61	371.6	366.8	353.1	327.6	304.7	276.9
14	57	371.8	366.9	353.2	327.7	304.8	278.5
12	54	372.0	367.0	353.3	327.8	304.9	278.6
10	50	372.2	367.2	353.3	327.9	304.9	278.7
8	46	372.3	367.3	353.4	327.9	304.9	278.7
6	43	372.5	367.4	350.4	328.0	304.9	272.8
4	40	372.6	367.4	341.5	313.7	286.7	254.9
2	36	372.7	367.5	341.6	313.8	286.8	254.9
0	32	372.8	367.5	341.6	313.8	286.8	255.0
-40	-40	373.4	367.8	341.6	313.8	286.8	255.0

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.**With engine bleed for packs off, increase weight by 1250 kg.****With engine and wing anti-ice on, decrease weight by 2350 kg.****When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 26950 kg.**

ENGINE INOP

ADVISORY INFORMATION

**Go-Around Climb Gradient
Flaps 20, Gear Up**

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.

OAT (°C)	REFERENCE GO-AROUND GRADIENT (%)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
54	9.16	7.98	6.54	5.32	4.09	2.49
50	10.10	8.98	7.32	5.99	4.73	3.07
46	11.06	9.95	8.21	6.69	5.39	3.66
42	11.98	10.90	9.09	7.48	6.08	4.27
38	12.83	11.81	9.96	8.25	6.75	4.90
34	13.01	12.64	10.76	8.97	7.32	5.49
30	13.03	12.79	11.43	9.64	7.87	5.98
26	13.06	12.80	11.74	10.19	8.48	6.46
22	13.08	12.81	11.75	10.46	8.89	6.98
18	13.10	12.83	11.75	10.47	9.15	7.33
14	13.13	12.84	11.76	10.47	9.15	7.55
10	13.15	12.85	11.77	10.48	9.16	7.55

Weight Adjustment

WEIGHT (1000 KG)	REFERENCE GO-AROUND GRADIENT (%)											
	2	3	4	5	6	7	8	9	10	11	12	13
320	-4.29	-4.77	-5.26	-5.74	-6.13	-6.59	-7.04	-7.50	-7.95	-8.45	-8.92	-9.39
300	-4.02	-4.44	-4.89	-5.32	-5.66	-6.08	-6.49	-6.90	-7.32	-7.77	-8.21	-8.64
280	-3.56	-3.94	-4.33	-4.72	-5.01	-5.38	-5.74	-6.10	-6.47	-6.89	-7.28	-7.67
260	-3.12	-3.43	-3.77	-4.11	-4.34	-4.66	-4.96	-5.26	-5.58	-5.95	-6.29	-6.63
240	-2.44	-2.67	-2.95	-3.23	-3.39	-3.64	-3.88	-4.11	-4.37	-4.68	-4.96	-5.23
220	-1.61	-1.76	-1.97	-2.17	-2.26	-2.43	-2.58	-2.74	-2.93	-3.15	-3.36	-3.52
200	-0.61	-0.66	-0.76	-0.81	-0.85	-0.91	-0.97	-1.03	-1.12	-1.20	-1.25	-1.28
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.66	0.75	0.85	0.88	0.94	1.00	1.07	1.17	1.26	1.30	1.33	1.36
160	2.37	2.67	2.86	3.00	3.20	3.44	3.71	3.95	4.13	4.22	4.33	4.44

Speed Adjustment

SPEED (KIAS)	WEIGHT ADJUSTED GO-AROUND GRADIENT (%)										
	-2	0	2	4	6	8	10	12	14	16	18
VREF	-0.23	-0.24	-0.25	-0.27	-0.28	-0.27	-0.23	-0.16	-0.07	0.03	0.10
VREF+5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VREF+10	0.17	0.18	0.19	0.20	0.21	0.19	0.15	0.07	-0.03	-0.11	-0.14
VREF+20	0.38	0.40	0.42	0.43	0.44	0.37	0.23	-0.01	-0.24	-0.42	-0.56
VREF+30	0.43	0.44	0.44	0.43	0.40	0.28	0.05	-0.28	-0.61	-0.90	-1.12

With engine bleed for packs off, increase gradient by 0.1%.

With engine and wing anti-ice on, decrease gradient by 0.1%.

When operating in icing conditions during any part of the flight with forecast landing temperatures below 10°C, decrease gradient by 1.2%.

Quick Turnaround Limit Weight**Flaps 30 Limit Weight (1000 KG)**

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	235.5				
50	122	237.0	228.2			
45	113	239.0	230.0	221.4		
40	104	240.9	231.9	223.2	214.8	
35	95	242.9	233.9	225.1	216.6	208.1
30	86	245.0	235.9	227.0	218.4	209.9
25	77	247.1	237.9	228.9	220.3	211.7
20	68	249.2	240.0	231.0	222.2	213.6
15	59	251.5	242.2	233.0	224.1	215.6
10	50	253.8	244.4	235.2	226.2	217.5
5	41	256.2	246.6	237.4	228.3	219.5
0	32	258.6	248.9	239.6	230.4	221.5
-5	23	261.0	251.3	241.9	232.6	223.6
-10	14	262.9	253.8	244.2	234.9	225.8
-15	5	264.8	256.4	246.7	237.3	228.1
-20	-4	266.8	259.0	249.2	239.7	230.4
-30	-22	270.8	263.5	254.4	244.7	235.3
-40	-40	276.0	267.7	260.0	250.1	240.4
-50	-58	282.2	272.0	264.6	255.7	245.8
-54	-65	284.7	274.4	266.4	258.1	248.0

Increase weight by 2100 kg per 1% uphill slope. Decrease weight by 3450 kg per 1% downhill slope.

Increase weight by 6100 kg per 10 knots headwind. Decrease weight by 29450 kg per 10 knots tailwind.

Decrease weight by 12600 kg when one brake is deactivated. Decrease weight by 24950 kg when two brakes are deactivated.

After landing at weights exceeding those shown above, adjusted for slope and wind, wait at least 65 minutes and check that wheel thermal plugs have not melted before executing a takeoff.

As an alternate procedure, no waiting period is required if the BRAKE TEMP advisory message on EICAS is not displayed 10 to 15 minutes after parking.

Intentionally
Blank

Performance Dispatch**Chapter PD****Gear Down****Section 33****GEAR DOWN****Takeoff Climb Limit Weight****Flaps 15****Based on engine bleed for packs on, engine anti-ice off, and wing anti-ice off**

AIRPORT OAT		TAKEOFF CLIMB WEIGHT (1000 KG)				
		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	236.9	225.2	209.9	189.5	159.7
52	126	242.3	226.1	214.7	195.1	166.9
50	122	248.1	227.3	217.1	200.5	173.2
48	118	254.1	232.9	217.0	205.8	178.4
46	115	259.9	238.4	218.2	206.1	183.5
44	111	264.7	243.7	223.0	206.0	188.5
42	108	269.1	249.0	227.9	207.1	191.2
40	104	273.8	254.4	233.0	211.6	191.1
38	100	280.0	260.2	238.4	216.4	192.3
36	97	286.2	264.9	243.9	221.5	196.7
34	93	292.5	269.6	249.6	226.7	201.3
32	90	298.3	274.8	255.0	231.8	206.2
30	86	303.7	280.9	260.5	237.2	211.1
28	82	308.6	286.8	265.2	242.4	215.9
26	79	308.7	292.3	269.3	247.6	221.0
24	75	308.8	296.1	273.6	252.7	225.9
22	72	308.9	296.2	278.0	256.7	231.0
20	68	309.0	296.2	280.6	260.0	235.5
18	64	309.1	296.3	280.7	262.7	239.0
16	61	309.2	296.3	280.7	263.7	240.7
14	57	309.3	296.4	280.7	263.7	242.0
12	54	309.4	296.4	280.7	263.7	242.1
10	50	309.5	296.5	280.7	263.7	242.1
-40	-40	309.8	296.5	280.9	263.7	242.0

With engine bleed for packs off, increase weight by 800 kg.**With engine anti-ice on, decrease weight by 900 kg.****With engine and wing anti-ice on, decrease weight by 2250 kg.**

GEAR DOWN

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 30

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)				
		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	249.4				
52	126	256.6				
50	122	264.0	241.5			
48	118	272.0	247.4			
46	115	278.7	254.0	234.8		
44	111	285.5	260.6	240.6		
42	108	291.8	268.0	246.3	227.7	
40	104	298.7	274.5	252.1	232.7	
38	100	305.4	280.9	257.9	237.6	211.3
36	97	312.2	286.5	263.0	241.7	215.6
34	93	318.6	292.0	268.8	245.7	219.8
32	90	320.7	297.6	273.8	249.3	223.5
30	86	320.8	302.8	278.7	253.2	226.8
28	82	320.9	307.5	283.1	257.2	230.1
26	79	321.1	307.6	286.4	261.7	233.4
24	75	321.2	307.7	288.9	266.2	237.0
22	72	321.3	307.7	289.9	269.2	240.7
20	68	321.4	307.8	290.0	271.0	243.8
18	64	321.5	307.9	290.0	272.8	246.0
16	61	321.6	308.0	290.1	272.8	247.5
14	57	321.8	308.0	290.1	272.9	248.9
12	54	321.9	308.1	290.1	272.9	249.0
10	50	322.0	308.2	290.2	272.9	249.0
-40	-40	322.5	308.5	290.5	273.1	249.2

With engine bleed for packs off, increase weight 1600 kg.

With engine and wing anti-ice on, decrease weight by 2150 kg.

When operating in icing conditions during any part of the flight when forecast landing temperature is below 10°C, decrease weight by 29150 kg.

GEAR DOWN**Takeoff Obstacle Limit Weight****Flaps 15****Sea Level, 33°C & Below, Zero Wind****Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or Auto**

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)											
	DISTANCE FROM BRAKE RELEASE (100 M)											
	25	30	35	40	45	50	55	60	65	70	75	
5	291.3											
20	268.3	287.6										
40	248.0	266.7	281.2	292.1								
60	235.1	251.1	265.7	277.4	286.6	294.1						
80	223.5	239.5	253.0	265.0	274.8	282.9	289.5	295.0				
100	212.0	230.2	242.8	254.4	264.5	272.9	280.1	286.1	291.2	295.6	298.2	
120	201.9	220.7	234.4	245.1	255.3	264.0	271.5	277.9	283.4	288.1	292.3	
140		211.8	226.7	237.7	247.1	256.0	263.6	270.3	276.1	281.2	285.6	
160		203.7	218.9	230.8	240.1	248.5	256.4	263.3	269.3	274.6	279.3	
180		196.2	211.6	224.0	233.9	242.1	249.8	256.8	263.0	268.5	273.3	
200			204.8	217.5	227.9	236.4	243.7	250.7	257.0	262.7	267.7	
220			198.4	211.3	222.1	230.9	238.4	245.1	251.4	257.2	262.4	
240			192.4	205.5	216.4	225.6	233.3	240.0	246.1	252.0	257.3	
260				199.9	211.1	220.5	228.4	235.3	241.4	247.1	252.5	
280				194.7	205.9	215.5	223.7	230.8	237.0	242.6	247.9	
300					201.0	210.8	219.2	226.4	232.7	238.4	243.6	

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustment

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
33 & BELOW	0	0	0	0	0	0	0	0
34	-1.2	-1.4	-1.5	-1.7	-1.8	-2.0	-2.1	-2.3
36	-4.7	-5.3	-5.9	-6.5	-7.1	-7.7	-8.2	-8.8
38	-8.3	-9.3	-10.3	-11.3	-12.3	-13.3	-14.3	-15.4
40	-11.8	-13.2	-14.7	-16.1	-17.6	-19.0	-20.4	-21.9
42	-15.0	-16.8	-18.7	-20.5	-22.4	-24.2	-26.0	-27.9
44	-18.2	-20.5	-22.7	-24.9	-27.2	-29.4	-31.6	-33.8
46	-21.5	-24.1	-26.7	-29.3	-32.0	-34.6	-37.2	-39.8
48	-24.7	-27.7	-30.7	-33.7	-36.8	-39.8	-42.8	-45.8
50	-27.9	-31.3	-34.7	-38.1	-41.6	-45.0	-48.4	-51.8

GEAR DOWN

Takeoff Obstacle Limit Weight

Flaps 15

Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
S.L. & BELOW	0	0	0	0	0	0	0	0
1000	-7.1	-7.9	-8.6	-9.4	-10.2	-10.9	-11.7	-12.4
2000	-14.3	-15.8	-17.3	-18.8	-20.3	-21.8	-23.3	-24.9
3000	-20.8	-23.0	-25.2	-27.4	-29.6	-31.8	-34.0	-36.2
4000	-27.3	-30.2	-33.1	-36.0	-38.9	-41.8	-44.7	-47.6
5000	-33.9	-37.5	-41.2	-44.8	-48.5	-52.1	-55.8	-59.4
6000	-40.5	-44.9	-49.3	-53.7	-58.0	-62.4	-66.8	-71.2
7000	-47.6	-52.8	-58.1	-63.3	-68.5	-73.7	-78.9	-84.1
8000	-54.8	-60.8	-66.8	-72.9	-78.9	-85.0	-91.0	-97.0

Wind Adjustment

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
15 TW	-34.2	-33.2	-32.1	-31.1	-30.1	-29.1	-28.0	-27.0
10 TW	-22.8	-22.1	-21.4	-20.7	-20.1	-19.4	-18.7	-18.0
5 TW	-11.4	-11.1	-10.7	-10.4	-10.0	-9.7	-9.3	-9.0
0	0	0	0	0	0	0	0	0
10 HW	4.2	3.6	3.0	2.4	1.8	1.1	0.5	0.0
20 HW	8.5	7.2	6.0	4.8	3.5	2.2	1.0	0.0
30 HW	12.8	10.9	9.0	7.1	5.2	3.4	1.5	0.0
40 HW	17.0	14.5	12.0	9.5	7.0	4.5	2.0	0.0

With engine bleed for packs off, increase weight by 500 kg.

With engine and wing anti-ice on, decrease weight by 3000 kg.

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
360	18500	16600	14200
350	19200	17300	14800
340	19700	18000	15500
330	20600	18900	16300
320	21700	20100	17600
310	22800	21300	19000
300	23900	22400	20300
290	25000	23500	21800
280	26000	24600	23000
270	27100	25900	24300
260	28200	27200	25700
250	29400	28600	27100
240	30400	30000	28500
230	31200	30800	29900
220	32000	31700	31000
210	32800	32600	32000
200	33500	33200	32700
190	34000	33900	33400
180	34600	34500	34100
170	35200	35100	34700
160	35800	35700	35300

GEAR DOWN

Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
326	291	261	237	217	200	188	177	167	158	150
488	436	391	355	326	300	282	266	251	238	227
649	580	521	473	434	400	376	354	335	318	303
809	724	650	591	543	500	470	443	419	398	380
968	867	779	709	651	600	565	533	504	479	456
1127	1009	908	826	759	700	659	622	589	559	533
1285	1152	1036	944	867	800	754	712	673	639	609
1442	1293	1165	1061	975	900	848	801	758	720	686
1599	1435	1293	1178	1083	1000	943	890	843	800	763
1755	1576	1421	1295	1191	1100	1037	980	928	881	840
1910	1716	1548	1412	1299	1200	1131	1069	1012	962	917
2065	1856	1675	1529	1407	1300	1226	1158	1097	1042	994
2219	1996	1802	1646	1515	1400	1320	1248	1182	1123	1072
2373	2135	1929	1762	1623	1500	1415	1337	1267	1204	1149
2526	2274	2056	1878	1730	1600	1509	1427	1352	1285	1226
2679	2413	2182	1994	1838	1700	1604	1516	1437	1366	1304
2831	2551	2308	2110	1945	1800	1699	1606	1522	1447	1382
2982	2689	2434	2226	2053	1900	1793	1696	1608	1529	1459
3133	2826	2559	2342	2160	2000	1888	1786	1693	1610	1537

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	7.8	0:51	7.4	0:49	7.2	0:47	7.0	0:46	6.9	0:44
300	11.4	1:13	10.8	1:10	10.4	1:07	10.0	1:05	9.7	1:03
400	15.0	1:36	14.2	1:32	13.6	1:28	13.0	1:25	12.6	1:22
500	18.6	1:59	17.6	1:53	16.7	1:48	16.0	1:44	15.4	1:40
600	22.3	2:21	21.1	2:14	20.0	2:08	19.1	2:03	18.4	1:58
700	26.1	2:43	24.6	2:35	23.3	2:28	22.2	2:22	21.3	2:17
800	29.8	3:05	28.1	2:56	26.6	2:48	25.3	2:41	24.2	2:35
900	33.6	3:27	31.6	3:17	29.9	3:08	28.4	3:00	27.2	2:53
1000	37.3	3:49	35.1	3:38	33.2	3:28	31.5	3:20	30.1	3:11
1100	41.3	4:10	38.8	3:59	36.7	3:48	34.7	3:38	33.2	3:29
1200	45.2	4:32	42.4	4:19	40.1	4:07	37.9	3:57	36.2	3:47
1300	49.1	4:53	46.1	4:39	43.5	4:27	41.2	4:15	39.3	4:04
1400	53.0	5:14	49.8	5:00	47.0	4:46	44.4	4:34	42.4	4:22
1500	57.0	5:36	53.4	5:20	50.4	5:05	47.6	4:52	45.5	4:40
1600	61.1	5:56	57.3	5:40	54.0	5:24	51.0	5:11	48.7	4:57
1700	65.2	6:17	61.1	5:59	57.6	5:43	54.4	5:29	51.9	5:15
1800	69.3	6:37	64.9	6:19	61.1	6:02	57.8	5:47	55.2	5:32
1900	73.4	6:58	68.7	6:39	64.7	6:21	61.2	6:05	58.4	5:49
2000	77.5	7:19	72.6	6:58	68.3	6:40	64.6	6:23	61.6	6:07

GEAR DOWN

**Long Range Cruise Trip Fuel and Time
Fuel Required Adjustments (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	160	180	200	220	240
5	-0.4	-0.2	0.0	0.3	0.7
10	-0.9	-0.5	0.0	0.6	1.3
15	-1.3	-0.7	0.0	0.9	2.0
20	-1.8	-1.0	0.0	1.3	2.7
25	-2.3	-1.3	0.0	1.6	3.5
30	-2.8	-1.6	0.0	2.0	4.2
35	-3.3	-1.9	0.0	2.3	5.0
40	-3.9	-2.1	0.0	2.7	5.9
45	-4.4	-2.4	0.0	3.1	6.7
50	-4.9	-2.7	0.0	3.5	7.6
55	-5.4	-2.9	0.0	3.9	8.5
60	-6.0	-3.2	0.0	4.4	9.4
65	-6.5	-3.5	0.0	4.8	10.4
70	-7.0	-3.7	0.0	5.2	11.3
75	-7.6	-4.0	0.0	5.7	12.3
80	-8.1	-4.2	0.0	6.2	13.4

Based on VREF+80 climb, Long Range Cruise and VREF+80 descent.

GEAR DOWN

Short Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
101	84	72	63	56	50	45	42	38	36	33
171	150	133	120	109	100	92	86	80	75	71
242	215	194	177	162	150	139	130	122	115	109
311	280	255	233	215	200	187	175	165	156	147
380	344	315	290	268	250	234	220	207	196	186
448	408	374	346	321	300	281	265	250	237	225
517	472	434	402	374	350	329	310	293	278	265
586	536	494	458	427	400	376	355	336	319	304
655	600	554	514	480	450	423	400	379	360	343
726	666	615	571	533	500	471	445	421	400	381

Trip Fuel and Time

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		160	180	200	220	240	
50	FUEL (1000 KG)	2.2	2.3	2.5	2.6	2.7	0:15
	ALT (FT)	13000	11000	11000	11000	11000	
100	FUEL (1000 KG)	3.7	3.9	4.1	4.3	4.5	0:25
	ALT (FT)	23000	21000	21000	19000	19000	
150	FUEL (1000 KG)	5.0	5.2	5.5	5.8	6.2	0:34
	ALT (FT)	29000	27000	25000	25000	23000	
200	FUEL (1000 KG)	6.2	6.5	6.9	7.3	7.8	0:43
	ALT (FT)	31000	29000	29000	27000	25000	
250	FUEL (1000 KG)	7.4	7.8	8.3	8.8	9.4	0:51
	ALT (FT)	33000	31000	29000	27000	25000	
300	FUEL (1000 KG)	8.6	9.1	9.6	10.3	11.0	1:00
	ALT (FT)	33000	31000	31000	29000	27000	
350	FUEL (1000 KG)	9.8	10.3	11.0	11.7	12.6	1:08
	ALT (FT)	33000	33000	31000	29000	27000	
400	FUEL (1000 KG)	11.0	11.6	12.3	13.2	14.2	1:16
	ALT (FT)	33000	33000	31000	29000	27000	
450	FUEL (1000 KG)	12.2	12.9	13.7	14.7	15.8	1:25
	ALT (FT)	33000	33000	31000	29000	27000	
500	FUEL (1000 KG)	13.4	14.2	15.1	16.2	17.5	1:33
	ALT (FT)	33000	33000	31000	29000	27000	

GEAR DOWN

**Holding Planning
Flaps Up**

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)						
	PRESSURE ALTITUDE (FT)						
	1500	5000	10000	15000	20000	25000	30000
360	15490						
340	14720	14710					
320	13780	13740					
300	12760	12730	12670				
280	11940	11920	11840				
260	11030	11010	10930	10980			
240	10300	10270	10190	10210			
220	9600	9550	9460	9460	9550		
200	9210	9140	9050	9030	9100	9210	
180	8900	8820	8720	8690	8750	8840	9040
160	8630	8540	8430	8390	8430	8510	8690

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
360	15330	15400	15380	15620	16410
340	14470	14510	14490	14690	15250
320	13540	13550	13540	13670	14090
300	12540	12540	12530	12650	12900
280	11680	11670	11630	11750	11960
260	10760	10730	10680	10790	10930
240	9970	9920	9860	9940	10050
220	9210	9140	9070	9110	9210
200	8700	8610	8520	8540	8620
180	8290	8190	8090	8090	8140
160	7950	7850	7720	7710	7730

These tables include 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
20	171.5	171.5	166.7
18	182.0	180.0	175.8
16	194.2	192.5	188.4
14	207.3	206.6	201.2
12	223.4	221.2	214.5
10	239.5	236.8	229.8
8	256.5	252.7	246.2
6	275.8	268.7	258.8
4	292.6	281.7	268.8
2	306.2	293.1	279.3
0	318.4	303.7	288.9

Anti-Ice Adjustments

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG)										
	PRESSURE ALTITUDE (1000 FT)										
	0	2	4	6	8	10	12	14	16	18	20
ENGINE ONLY	0.0	-0.7	-1.2	-1.2	-1.1	-0.9	-0.7	-0.2	0.0	0.0	0.0
ENGINE AND WING	-2.3	-3.0	-3.0	-3.2	-2.7	-2.4	-1.9	-1.6	-1.3	-1.0	-0.7

Performance Dispatch**Text****Chapter PD****Section 34**

Introduction

This chapter contains self dispatch performance data intended primarily for use by flight crews in the event that information cannot be obtained from the airline dispatch office. The data provided is for a single takeoff flap at max takeoff thrust. The range of conditions covered is limited to those normally encountered in airline operation. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

Takeoff

The maximum allowable takeoff weight will be the least of the Field, Climb, Tire Speed, and Obstacle Limit Weights as determined from the following tables. Brake Energy Limit is not shown as it is not limiting for the range of conditions shown in this chapter. When determining a maximum weight for a wet runway, the dry runway limit weight must also be checked and the lower of the two weights used.

Minimum Takeoff Weight

Light weight takeoffs at the GE90-110B1L thrust rating may be limited by minimum takeoff weight in order to maintain airplane controllability during takeoff. For takeoff at weights below the minimum takeoff weight, use of a lower thrust rating and/or the assumed temperature method of thrust reduction is required.

Field Limit Weight - Slope and Wind Corrections

These tables for wet and dry runways provide corrections to the field length available for the effects of runway slope and wind component along the runway. Enter the Slope Correction table with the available field length and runway slope to determine the slope corrected field length. Now enter the Wind Correction table with slope corrected field length and wind component to determine the slope and wind corrected field length.

Field and Climb Limit Weight

Tables are presented for selected airport pressure altitudes and runway condition and show both Field and Climb Limit Weights. Enter the appropriate table for pressure altitude and runway condition with “Slope and Wind Corrected Field Length” determined above and airport OAT to

obtain Field Limit Weight. Also read Climb Limit Weight for the same OAT. Intermediate altitudes may be interpolated or use next higher altitude.

When finding a maximum weight for a wet runway, the dry runway limit weight must also be determined and the lower of the two weights used.

Obstacle Limit Weight

This table provides obstacle limit weights for reference airport conditions based on obstacle height above the runway surface and distance from brake release. Enter the correction tables to correct the reference Obstacle Limit Weight for the effects of OAT, pressure altitude and wind as indicated. In the case of multiple obstacles, enter the tables successively with each obstacle and determine the most limiting weight.

Tire Speed Limit

Maximum tire speed limited weights are presented for 235 MPH tires. To determine the tire speed limit weight, enter the table with OAT, move to airport pressure altitude and read the tire speed limit weight. Adjust the tire speed limit weight according to the notes below the table to account for wind.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table as well as FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. This typically occurs at full rated thrust and light weights and is shown in the Minimum Takeoff Weight tables provided. The options are to select a smaller flaps setting, use reduced takeoff thrust and/or add weight (fuel). Selecting derate thrust is the preferred method of reduced takeoff thrust as this will reduce the minimum control speeds.

Normal takeoff speeds, V1, VR, and V2 are read from either the wet or dry table by entering with takeoff flap setting and brake release weight. Use the tables provided to correct takeoff speeds for altitude and actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind corrections to V1 are obtained by entering the Slope and Wind V1 Adjustment Table.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than the minimum V1 for control on the ground, V1(MCG). It is therefore necessary to compare the adjusted V1 to V1(MCG). To find V1(MCG), enter the V1(MCG) table with airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than V1(MCG), set VR equal to V1(MCG) and determine a new V2 by adding the difference between the normal VR and V1(MCG) to the normal V2. No weight adjustment is required provided that the field length available exceeds the minimum field length required shown in the Field and Climb Limit Weight table.

Minimum V2

Minimum takeoff safety speeds (V2) are provided to ensure an adequate margin between the normal operating speed and the in-air minimum control speed is maintained for directional control with high thrust asymmetry during a light weight takeoff.

Data are presented as a function of airport pressure altitude and are valid for all temperatures. To obtain the proper V2 speed for takeoff, first determine the normal takeoff V2 using the takeoff speeds tables provided, adjusted for pressure altitude, temperature, and VR correction (if applicable). Compare this V2 with the minimum V2. If the calculated V2 is less than the minimum V2, set V2 equal to minimum V2 and determine a new VR by adding the difference between calculated V2 and minimum V2 to the original VR obtained from the V1, VR, V2 Adjustments table or Minimum VR table (if applicable).

Brakes Deactivated

When operating with brakes deactivated, the field limit weight and the V1 must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway limited weight by 3700 kg for a dry runway or 2200 kg for a wet runway and the V1 associated with the reduced weight by 2 knots. With two brakes deactivated, reduce the normal runway limited weight by 7250 kg for a dry runway or 4550 kg for a wet runway and the V1 associated with the

reduced weight by 5 knots for a dry runway or 3 knots for a wet runway. If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the dry accelerate stop distance corrected for wind and slope exceeds approximately 1800 m for one brake deactivated or 1900 m for two brakes deactivated. For wet runways, the corrected accelerate stop distance should exceed approximately 2350 m for one brake deactivated or 2450 m for two brakes deactivated.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

One Thrust Reverser Inoperative

Wet runway takeoff performance presented for all brakes operating is based on the use of one thrust reverser during deceleration. When operating with a thrust reverser inoperative, the runway/obstacle limited takeoff weight and V1 speed must be reduced to account for the reduced deceleration capability. A simplified method which conservatively accounts for this is to reduce the normal wet runway/obstacle limited weight by 6900 kg and the V1 associated with the reduced weight by 3 knots.

If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate stop distance available corrected for wind and slope exceeds approximately 2400 m.

Enroute

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination. Data is based on economy climb and descent speeds, and Long Range Cruise with normal engine bleed for air conditioning. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine trip fuel and time for a constant altitude cruise, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time Table with air distance from the Ground to Air Miles Conversion Table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment Table with the Reference Fuel and the planned landing weight to obtain fuel required at the planned landing weight.

Long Range Cruise Step Climb Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination when flying a step climb profile. Step climb profiles are based on 4000 ft step climbs to keep the flight within 2000 ft of the optimum altitude for the current cruise weight. To determine trip fuel and time, enter the Ground to Air Miles Conversion table and determine air distance as discussed above. Then enter the Trip Fuel and Time required with air distance and planned landing weight to read trip fuel. Continue across the table to read trip time.

Short Trip Fuel and Time

These tables are provided to determine trip fuel and time for short distances or alternates. The data considers the use of the FMC short trip optimum altitude. Obtain air distance from upper table using the ground distance and wind component to the alternate. Enter Trip Fuel and Time table with air distance and read trip fuel required for the expected landing weight, together with time to alternate at right. For distances greater than shown or other altitudes, use the Long Range Cruise Trip Fuel and Time tables.

Holding Planning

These tables provide total fuel flow information necessary for planning Flaps Up and Flaps 1 holding and reserve fuel requirements. Data is based on the FMC holding speed schedule which is the higher of the maximum

endurance and flaps up maneuver speeds. As noted, the fuel flow is based on flight in a racetrack holding pattern. For holding in straight and level flight, reduce table values by 5%.

Oxygen Requirements

Flight Crew System

Regulations require that sufficient oxygen be provided to the flight crew to account for the greater of supplemental breathing oxygen in the event of a cabin depressurization or protective breathing in the event of smoke or harmful fumes in the flight deck. The oxygen quantity associated with these requirements is achieved with the minimum dispatch oxygen cylinder pressure. Enter the Crew Oxygen Requirements table with the number of crew plus observers using oxygen and read the minimum cylinder pressure required for the appropriate bottle temperature.

An additional quantity of oxygen is required when flight altitudes above 41000 ft are planned. Regulations require that one active duty pilot must don the oxygen mask and breathe diluted oxygen for the duration of the flight above 41000 ft. The additional quantity of oxygen required is 2.05 liters/person/minute (0.6 psi/person/minute for the dual cylinder system), or 13 liters/person/minute (4 psi/person/minute) if 100% oxygen is selected during normal usage.

Net Level Off Weight

The Net Level Off Weight table is provided to determine terrain clearance capability in straight and level flight following an engine failure. Regulations require terrain clearance planning based on net performance which is the gross (or actual) gradient performance degraded by 1.1%. In addition, the net level off pressure altitude must clear the terrain by 1000 ft.

To determine the maximum weight for terrain clearance, enter the table with required net level off pressure altitude and expected ISA deviation to obtain weight. Adjust weight for anti-ice operation as noted below the table.

Extended Range Operations

Regulations require that flights conducted over a route that contains a point further than one hour's time at "normal one engine inoperative speed" from an adequate diversion airport comply with rules set up specifically for "Extended Range Operation with Two Engine airplanes". This section provides reserve fuel planning information for the "Critical Fuel Scenario" based on two engine operation at Long Range Cruise as well as single engine operation at Long Range Cruise.

Critical Fuel Reserves

Enter Ground to Air Mile Conversion table with forecast wind and ground distance to diversion airport from critical point to obtain air distance. Now enter Critical Fuel table with air distance and expected weight at the critical point and read required fuel. Apply the noted fuel adjustments as necessary. Regulations require a 5% allowance for performance deterioration unless a value has been established by the operator for in-service deterioration.

As noted below each table, the fuel required is the greater of the two engine fuel and the single engine fuel. This fuel is compared to the amount of fuel normally onboard the airplane at that point in the route. If the fuel required by the critical fuel reserves exceeds the amount of fuel normally expected, the fuel load must be adjusted accordingly.

Landing

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for Flaps 30.

Maximum landing weight is the lowest of the field length limit weight, climb limit weight or maximum certified landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required.

Go-Around Climb Gradient

Enter the Reference Go-around Gradient table with airport OAT and pressure altitude to determine the reference Go-Around Gradient. Then adjust the reference gradient for airplane weight and speed using the tables provided to determine the weight and speed adjusted Go-Around Gradient. Apply the necessary engine bleed corrections as noted. Note that data is for one engine inoperative.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted adjustments as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent takeoff, or ensure the brake temperature is within limits using the alternate procedure described on the page.

Gear Down

This section provides flight planning data for revenue operation with gear down.

Takeoff/Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to determine Takeoff Climb Limit Weight with gear down. Correct the weight obtained for engine bleed configuration as required.

The remaining gear down tables in this section are identical in format and usage to the corresponding gear up tables previously described.

Performance Dispatch**Chapter PD****Table of Contents****Section 40****777F GE90-110B1L KG JAA**

Takeoff.....	PD.40.1
Minimum Takeoff Weight.....	PD.40.1
Takeoff Field Corrections - Dry Runway.....	PD.40.2
Takeoff Field & Climb Limit Weights - Dry Runway.....	PD.40.3
Takeoff Field Corrections - Wet Runway.....	PD.40.6
Takeoff Field & Climb Limit Weights - Wet Runway.....	PD.40.7
Takeoff Obstacle Limit Weight.....	PD.40.10
Tire Speed Limit.....	PD.40.11
Takeoff Speeds - Dry Runway.....	PD.40.12
Takeoff Speeds - Wet Runway.....	PD.40.14
 Enroute	 PD.41.1
Long Range Cruise Maximum Operating Altitude.....	PD.41.1
Long Range Cruise Trip Fuel and Time.....	PD.41.3
Long Range Cruise Step Climb Trip Fuel and Time.....	PD.41.5
Short Trip Fuel and Time.....	PD.41.6
Holding Planning.....	PD.41.7
Crew Oxygen Requirements.....	PD.41.8
Net Level Off Weight.....	PD.41.9
Long Range Cruise Critical Fuel Reserves.....	PD.41.10
 Landing	 PD.42.1
Landing Field Limit Weight - Dry Runway.....	PD.42.1
Landing Field Limit Weight - Wet Runway.....	PD.42.2
Landing Climb Limit Weight.....	PD.42.3
Go-Around Climb Gradient.....	PD.42.4
Quick Turnaround Limit Weight.....	PD.42.5
 Gear Down.....	 PD.43.1
Takeoff Climb Limit Weight.....	PD.43.1

Landing Climb Limit Weight	PD.43.2
Takeoff Obstacle Limit Weight	PD.43.3
Long Range Cruise Altitude Capability	PD.43.5
Long Range Cruise Trip Fuel and Time	PD.43.6
Short Trip Fuel and Time	PD.43.8
Holding Planning	PD.43.9
Net Level Off Weight	PD.43.10
Text.	PD.44.1
Introduction	PD.44.1
Takeoff	PD.44.1
Enroute	PD.44.5
Landing	PD.44.7
Gear Down	PD.44.8

Performance Dispatch
Takeoff

Chapter PD
Section 40

Minimum Takeoff Weight
Weight Limit (1000 KG)
Flaps 15
Based on engine bleed for packs on and anti-ice off.

OAT (°C)	AIRPORT PRESSURE ALTITUDE (FT)								
	S.L. & BELOW	1000	2000	3000	4000	5000	6000	7000	8000 & ABOVE
50	165.5	158.6							
45	175.9	169.0	161.5	155.1					
40	186.0	178.7	171.2	164.4	158.0				
35	195.0	187.6	179.8	172.8	166.0	159.6			
30	197.6	193.8	186.9	179.7	172.7	166.1	158.8		
25	197.7	193.8	189.3	184.6	178.4	172.6	164.7	156.1	
20	197.8	193.9	189.4	184.6	179.8	175.1	168.4	160.7	
15	198.0	194.0	189.4	184.6	179.8	175.1	169.4	162.6	155.4
10	198.1	194.0	189.5	184.7	179.8	175.1	169.4	162.6	155.8
0 & BELOW	198.2	194.2	189.6	184.7	179.9	175.1	169.4	162.6	155.8

Light weight takeoffs at the GE90-110B1L thrust rating may be limited by minimum takeoff weight in order to maintain airplane controllability during takeoff. For takeoff at weights below the minimum takeoff weight, use of a lower thrust rating and/or the assumed temperature method of thrust reduction is required.

Takeoff Field Corrections - Dry Runway
Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH (M)								
	RUNWAY SLOPE (%)								
	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
1200	1230	1220	1220	1210	1200	1190	1180	1160	1150
1400	1460	1440	1430	1410	1400	1380	1350	1330	1310
1600	1680	1660	1640	1620	1600	1570	1530	1500	1470
1800	1900	1870	1850	1820	1800	1760	1710	1670	1620
2000	2120	2090	2060	2030	2000	1950	1890	1840	1780
2200	2340	2310	2270	2240	2200	2130	2070	2000	1940
2400	2570	2520	2480	2440	2400	2320	2250	2170	2100
2600	2790	2740	2690	2650	2600	2510	2430	2340	2250
2800	3010	2960	2910	2850	2800	2700	2610	2510	2410
3000	3230	3170	3120	3060	3000	2890	2780	2680	2570
3200	3460	3390	3330	3260	3200	3080	2960	2840	2730
3400	3680	3610	3540	3470	3400	3270	3140	3010	2880
3600	3900	3820	3750	3670	3600	3460	3320	3180	3040
3800	4120	4040	3960	3880	3800	3650	3500	3350	3200
4000	4340	4260	4170	4090	4000	3840	3680	3520	3350
4200	4570	4470	4380	4290	4200	4030	3860	3680	3510
4400	4790	4690	4590	4500	4400	4220	4030	3850	3670
4600	5010	4910	4810	4700	4600	4410	4210	4020	3830
4800	5230	5120	5020	4910	4800	4600	4390	4190	3980
5000	5450	5340	5230	5110	5000	4790	4570	4360	4140

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M)							
	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1200	890	990	1100	1200	1280	1350	1430	1520
1400	1060	1170	1290	1400	1480	1560	1650	1740
1600	1220	1350	1470	1600	1690	1780	1870	1960
1800	1390	1530	1660	1800	1890	1990	2080	2180
2000	1560	1710	1850	2000	2100	2200	2300	2410
2200	1720	1880	2040	2200	2300	2410	2520	2630
2400	1890	2060	2230	2400	2510	2620	2740	2850
2600	2060	2240	2420	2600	2710	2830	2950	3080
2800	2230	2420	2610	2800	2920	3040	3170	3300
3000	2390	2600	2800	3000	3130	3250	3390	3520
3200	2560	2770	2990	3200	3330	3470	3600	3740
3400	2730	2950	3180	3400	3540	3680	3820	3970
3600	2890	3130	3360	3600	3740	3890	4040	4190
3800	3060	3310	3550	3800	3950	4100	4250	4410
4000	3230	3490	3740	4000	4150	4310	4470	4640
4200	3400	3660	3930	4200	4360	4520	4690	4860
4400	3560	3840	4120	4400	4560	4730	4910	5080
4600	3730	4020	4310	4600	4770	4940	5120	5310
4800	3900	4200	4500	4800	4980	5160	5340	5530
5000	4060	4380	4690	5000	5180	5370	5560	5750

Takeoff Field & Climb Limit Weights - Dry Runway**Flaps 15****Sea Level Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
1700	278.9	253.1	251.5	249.5	248.3	247.5	245.6	240.3	232.4	225.8	218.9
1800	287.9	261.4	259.6	257.6	256.4	255.6	253.6	248.1	240.0	233.2	226.1
2000	304.4	276.6	274.8	272.6	271.3	270.5	268.4	262.7	254.2	247.0	239.5
2200	320.1	290.9	289.0	286.8	285.4	284.6	282.4	276.4	267.5	259.9	252.2
2400	334.7	304.4	302.4	300.1	298.7	297.8	295.5	289.3	280.0	272.2	264.1
2600	347.9	316.7	314.6	312.2	310.8	309.8	307.5	301.0	291.5	283.4	275.1
2800	361.1	329.0	326.9	324.4	322.9	321.9	319.5	312.9	303.1	294.7	286.2
3000	372.0	339.0	336.9	334.3	332.8	331.8	329.3	322.5	312.4	303.9	295.1
3200	378.7	348.5	346.3	343.7	342.2	341.1	338.6	331.6	321.3	312.5	303.5
3400	378.7	357.6	355.4	352.7	351.1	350.1	347.5	340.3	329.8	320.8	311.6
3600	378.7	366.3	364.1	361.3	359.7	358.6	356.0	348.7	337.9	328.7	319.3
3800	378.7	374.6	372.3	369.5	367.8	366.7	364.1	356.6	345.6	336.3	326.6
4000	378.7	378.7	378.7	377.3	375.6	374.5	371.8	364.2	353.0	343.5	333.7
4200	378.7	378.7	378.7	378.7	378.7	378.7	378.7	371.5	360.1	350.4	340.5
4400	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.5	367.0	357.1	347.0
4600	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	373.6	363.6	353.3
4800	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	369.8	359.4
5000	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	375.7	365.2
CLIMB LIMIT WT (1000 KG)	350.8	350.2	350.0	349.7	349.6	349.4	349.1	336.7	319.5	305.3	290.6

2000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
1700	263.7	239.8	238.3	236.4	235.3	234.6	228.7	223.1	215.4	208.7	201.6
1800	272.3	247.6	246.1	244.1	243.0	242.2	236.2	230.4	222.5	215.6	208.3
2000	288.1	262.1	260.5	258.5	257.3	256.5	250.1	244.0	235.7	228.5	220.7
2200	302.9	275.8	274.1	272.0	270.7	269.9	263.2	256.9	248.2	240.6	232.5
2400	316.9	288.7	286.9	284.7	283.4	282.5	275.6	269.0	260.0	252.1	243.7
2600	329.5	300.4	298.6	296.3	295.0	294.1	286.9	280.1	270.8	262.7	254.0
2800	342.2	312.3	310.4	308.0	306.7	305.7	298.4	291.4	281.8	273.4	264.5
3000	352.6	321.9	319.9	317.5	316.1	315.2	307.6	300.4	290.6	282.0	272.8
3200	362.5	331.0	329.0	326.5	325.1	324.1	316.3	309.0	298.9	290.1	280.7
3400	371.9	339.7	337.6	335.1	333.6	332.6	324.7	317.2	306.9	297.9	288.2
3600	378.7	348.0	345.9	343.4	341.8	340.8	332.7	325.0	314.5	305.3	295.5
3800	378.7	355.9	353.8	351.2	349.6	348.6	340.3	332.5	321.7	312.3	302.3
4000	378.7	363.5	361.3	358.6	357.1	356.0	347.6	339.6	328.7	319.1	308.9
4200	378.7	370.8	368.6	365.9	364.3	363.2	354.6	346.5	335.4	325.7	315.3
4400	378.7	377.8	375.6	372.8	371.2	370.1	361.4	353.2	341.8	332.0	321.4
4600	378.7	378.7	378.7	378.7	377.9	376.7	367.9	359.6	348.1	338.1	327.3
4800	378.7	378.7	378.7	378.7	378.7	378.7	374.2	365.7	354.1	343.9	333.1
5000	378.7	378.7	378.7	378.7	378.7	378.7	378.7	371.6	359.8	349.5	338.5
CLIMB LIMIT WT (1000 KG)	335.7	335.5	335.4	335.2	335.1	334.9	322.6	310.6	294.2	280.3	266.6

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.

With engine and wing anti-ice on, decrease field limit weight by 1200 kg and climb limit weight by 2100 kg.

Takeoff Field & Climb Limit Weights - Dry Runway

Flaps 15

4000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
1700	247.9	225.9	224.5	222.7	220.3	218.3	212.3	206.9	199.0	192.7	186.8
1800	256.0	233.3	231.8	230.0	227.6	225.5	219.3	213.8	205.6	199.1	193.0
2000	270.9	247.1	245.5	243.6	241.0	238.8	232.3	226.5	218.0	211.1	204.7
2200	285.0	260.1	258.4	256.5	253.7	251.5	244.6	238.6	229.6	222.4	215.8
2400	298.2	272.3	270.6	268.6	265.7	263.4	256.3	250.0	240.7	233.2	226.3
2600	310.3	283.5	281.8	279.7	276.7	274.3	267.0	260.5	250.9	243.1	236.0
2800	322.4	294.9	293.1	290.9	287.9	285.4	277.8	271.2	261.3	253.3	245.9
3000	332.3	304.0	302.2	299.9	296.9	294.3	286.5	279.7	269.5	261.4	253.8
3200	341.6	312.7	310.8	308.5	305.3	302.7	294.8	287.7	277.3	269.0	261.2
3400	350.6	320.9	319.0	316.7	313.4	310.7	302.6	295.4	284.8	276.2	268.3
3600	359.1	328.9	326.9	324.5	321.2	318.4	310.2	302.8	291.9	283.2	275.1
3800	367.3	336.4	334.4	331.9	328.6	325.8	317.3	309.8	298.7	289.8	281.5
4000	375.0	343.6	341.6	339.1	335.6	332.8	324.2	316.5	305.2	296.2	287.7
4200	378.7	350.6	348.5	345.9	342.5	339.6	330.8	323.0	311.6	302.3	293.8
4400	378.7	357.3	355.2	352.6	349.1	346.1	337.2	329.3	317.6	308.2	299.6
4600	378.7	363.7	361.6	359.0	355.4	352.4	343.3	335.3	323.5	314.0	305.2
4800	378.7	369.9	367.8	365.1	361.5	358.4	349.3	341.2	329.2	319.5	310.6
5000	378.7	375.9	373.7	371.0	367.3	364.2	355.0	346.8	334.6	324.8	315.8
CLIMB LIMIT WT (1000 KG)	317.5	317.3	317.2	317.1	313.2	309.7	297.2	286.7	271.5	259.0	248.1

6000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
1700	232.4	211.8	210.5	207.2	203.8	201.2	195.4	190.5	183.6	178.0	172.6
1800	240.0	218.8	217.4	214.0	210.5	207.9	201.9	196.8	189.7	184.0	178.4
2000	254.2	231.8	230.4	226.8	223.1	220.4	214.0	208.7	201.3	195.2	189.3
2200	267.5	244.1	242.6	238.9	235.0	232.1	225.5	219.9	212.2	205.8	199.7
2400	280.0	255.7	254.2	250.3	246.3	243.3	236.4	230.6	222.5	215.9	209.5
2600	291.5	266.4	264.8	260.8	256.7	253.5	246.5	240.5	232.1	225.3	218.7
2800	303.1	277.3	275.6	271.5	267.2	264.0	256.7	250.6	242.0	235.0	228.2
3000	312.4	286.0	284.2	280.0	275.7	272.4	264.9	258.6	249.7	242.5	235.6
3200	321.3	294.2	292.4	288.1	283.6	280.2	272.6	266.1	257.0	249.7	242.5
3400	329.8	302.0	300.2	295.8	291.2	287.7	279.9	273.3	264.0	256.5	249.2
3600	337.9	309.5	307.7	303.2	298.5	295.0	287.0	280.2	270.7	263.0	255.6
3800	345.6	316.7	314.8	310.2	305.4	301.8	293.6	286.7	277.1	269.2	261.6
4000	353.0	323.5	321.6	316.9	312.1	308.4	300.1	293.0	283.2	275.2	267.5
4200	360.1	330.1	328.2	323.4	318.5	314.7	306.3	299.1	289.1	281.0	273.1
4400	367.0	336.5	334.5	329.7	324.7	320.9	312.3	305.0	294.9	286.6	278.6
4600	373.6	342.7	340.7	335.7	330.7	326.8	318.1	310.7	300.4	292.0	283.9
4800	378.7	348.6	346.6	341.6	336.4	332.5	323.7	316.2	305.8	297.2	289.0
5000	378.7	354.3	352.2	347.2	342.0	338.0	329.0	321.5	310.9	302.3	294.0
CLIMB LIMIT WT (1000 KG)	297.9	297.9	297.8	293.5	287.5	282.8	272.4	263.5	250.7	240.1	230.1

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.
With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.
With engine and wing anti-ice on, decrease field limit weight by 1200 kg and climb limit weight by 2100 kg.

Takeoff Field & Climb Limit Weights - Dry Runway**Flaps 15****8000 FT Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
1700	215.1	194.9	192.4	187.7	184.3	182.2	176.8	171.9	165.5	160.4	155.4
1800	222.2	201.4	198.8	193.9	190.4	188.2	182.8	177.7	171.1	165.8	160.7
2000	235.4	213.5	210.8	205.7	202.0	199.7	193.9	188.6	181.6	176.1	170.7
2200	247.9	225.0	222.1	216.8	212.9	210.5	204.5	198.9	191.6	185.9	180.2
2400	259.7	235.8	232.9	227.3	223.3	220.8	214.5	208.8	201.2	195.2	189.3
2600	270.5	245.9	242.8	237.0	232.9	230.3	223.9	217.9	210.1	203.9	197.8
2800	281.4	256.1	253.0	247.0	242.8	240.2	233.5	227.4	219.3	213.0	206.7
3000	290.2	264.2	261.0	254.9	250.6	247.9	241.0	234.8	226.5	220.0	213.5
3200	298.5	271.9	268.6	262.4	257.9	255.1	248.1	241.7	233.2	226.5	219.9
3400	306.5	279.2	275.9	269.5	265.0	262.1	254.9	248.3	239.6	232.8	226.1
3600	314.1	286.3	282.8	276.3	271.7	268.7	261.4	254.7	245.8	238.8	231.9
3800	321.3	292.9	289.4	282.8	278.1	275.1	267.6	260.7	251.7	244.6	237.5
4000	328.3	299.4	295.8	289.0	284.2	281.1	273.5	266.5	257.3	250.1	242.9
4200	335.0	305.6	301.9	295.0	290.1	287.0	279.3	272.2	262.8	255.4	248.2
4400	341.4	311.6	307.9	300.9	295.9	292.7	284.9	277.7	268.1	260.6	253.3
4600	347.6	317.3	313.6	306.5	301.4	298.2	290.3	282.9	273.3	265.7	258.2
4800	353.6	322.9	319.1	311.9	306.8	303.6	295.5	288.1	278.2	270.6	263.0
5000	359.4	328.3	324.4	317.1	312.0	308.7	300.5	293.0	283.0	275.3	267.6
CLIMB LIMIT WT (1000 KG)	273.7	273.7	270.6	262.7	256.7	253.2	243.8	234.7	222.5	213.2	204.0

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.

With engine and wing anti-ice on, decrease field limit weight by 1200 kg and climb limit weight by 2100 kg.

Takeoff Field Corrections - Wet Runway
Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH (M)								
	RUNWAY SLOPE (%)								
	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
1200	1230	1220	1210	1210	1200	1190	1170	1160	1150
1400	1450	1440	1430	1410	1400	1380	1360	1340	1320
1600	1670	1660	1640	1620	1600	1570	1550	1520	1490
1800	1900	1870	1850	1820	1800	1770	1730	1700	1660
2000	2120	2090	2060	2030	2000	1960	1920	1880	1840
2200	2350	2310	2270	2240	2200	2150	2100	2060	2010
2400	2570	2530	2490	2440	2400	2350	2290	2240	2180
2600	2800	2750	2700	2650	2600	2540	2480	2420	2360
2800	3020	2960	2910	2850	2800	2730	2660	2600	2530
3000	3240	3180	3120	3060	3000	2930	2850	2780	2700
3200	3470	3400	3330	3270	3200	3120	3040	2950	2870
3400	3690	3620	3550	3470	3400	3310	3220	3130	3050
3600	3920	3840	3760	3680	3600	3500	3410	3310	3220
3800	4140	4060	3970	3890	3800	3700	3600	3490	3390
4000	4360	4270	4180	4090	4000	3890	3780	3670	3560
4200	4590	4490	4390	4300	4200	4080	3970	3850	3740
4400	4810	4710	4610	4500	4400	4280	4150	4030	3910
4600	5040	4930	4820	4710	4600	4470	4340	4210	4080
4800	5260	5150	5030	4920	4800	4660	4530	4390	4250
5000	5490	5360	5240	5120	5000	4860	4710	4570	4430

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M)							
	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1200	850	970	1080	1200	1280	1370	1450	1550
1400	1020	1150	1270	1400	1490	1580	1670	1770
1600	1190	1330	1460	1600	1690	1790	1890	2000
1800	1360	1500	1650	1800	1900	2010	2110	2230
2000	1520	1680	1840	2000	2110	2220	2330	2460
2200	1690	1860	2030	2200	2310	2430	2560	2680
2400	1860	2040	2220	2400	2520	2640	2780	2910
2600	2030	2220	2410	2600	2730	2860	3000	3140
2800	2190	2400	2600	2800	2930	3070	3220	3370
3000	2360	2570	2790	3000	3140	3280	3440	3590
3200	2530	2750	2980	3200	3340	3500	3660	3820
3400	2700	2930	3170	3400	3550	3710	3880	4050
3600	2860	3110	3350	3600	3760	3920	4100	4280
3800	3030	3290	3540	3800	3960	4140	4320	4510
4000	3200	3470	3730	4000	4170	4350	4540	4730
4200	3370	3640	3920	4200	4380	4560	4760	4960
4400	3530	3820	4110	4400	4580	4780	4980	5190
4600	3700	4000	4300	4600	4790	4990	5200	5420
4800	3870	4180	4490	4800	5000	5200	5420	5640
5000	4040	4360	4680	5000	5200	5410	5640	5870

Takeoff Field & Climb Limit Weights - Wet Runway**Flaps 15****Sea Level Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
2240	320.5	289.1	287.1	284.7	283.3	282.3	280.0	273.6	264.2	256.3	248.2
2400	331.9	299.3	297.2	294.7	293.2	292.3	289.9	283.2	273.5	265.3	256.9
2600	345.5	311.5	309.4	306.8	305.3	304.2	301.8	294.8	284.6	276.1	267.4
2800	359.8	324.5	322.3	319.5	317.9	316.9	314.3	307.1	296.5	287.7	278.6
3000	371.9	335.3	333.0	330.2	328.5	327.4	324.7	317.3	306.3	297.1	287.7
3200	378.7	345.7	343.3	340.4	338.7	337.6	334.8	327.0	315.7	306.2	296.5
3400	378.7	355.7	353.2	350.2	348.5	347.3	344.4	336.4	324.8	314.9	304.9
3600	378.7	365.3	362.8	359.7	357.9	356.7	353.7	345.5	333.5	323.4	313.0
3800	378.7	374.5	371.9	368.7	366.9	365.6	362.6	354.1	341.8	331.4	320.8
4000	378.7	378.7	378.7	377.4	375.5	374.2	371.1	362.5	349.8	339.2	328.3
4200	378.7	378.7	378.7	378.7	378.7	378.7	378.7	370.5	357.6	346.7	335.6
4400	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.4	365.1	354.0	342.6
4600	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	372.4	361.1	349.5
4800	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	367.9	356.1
5000	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	374.5	362.5
5200	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	368.7
5400	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	374.6
5600	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7
CLIMB LIMIT WT (1000 KG)	350.8	350.2	350.0	349.7	349.6	349.4	349.1	336.7	319.5	305.3	290.6

2000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
2240	301.7	272.9	271.0	268.8	267.5	266.6	259.5	252.9	243.9	236.3	228.8
2400	312.3	282.5	280.6	278.2	276.9	275.9	268.6	261.7	252.4	244.5	236.7
2600	325.2	294.0	292.0	289.6	288.2	287.2	279.6	272.4	262.7	254.5	246.4
2800	338.6	306.3	304.2	301.7	300.2	299.2	291.3	283.8	273.7	265.2	256.7
3000	349.9	316.4	314.3	311.7	310.1	309.1	300.9	293.1	282.7	273.8	265.1
3200	360.9	326.2	324.0	321.3	319.7	318.6	310.1	302.1	291.2	282.1	273.0
3400	371.4	335.5	333.3	330.5	328.9	327.7	318.9	310.7	299.5	290.1	280.7
3600	378.7	344.6	342.2	339.4	337.7	336.5	327.5	319.0	307.5	297.8	288.1
3800	378.7	353.2	350.8	347.8	346.1	344.9	335.6	326.9	315.1	305.1	295.2
4000	378.7	361.5	359.0	356.0	354.3	353.0	343.5	334.6	322.5	312.3	302.1
4200	378.7	369.5	367.0	364.0	362.1	360.9	351.1	342.0	329.6	319.2	308.8
4400	378.7	377.3	374.8	371.6	369.8	368.5	358.5	349.2	336.6	325.9	315.3
4600	378.7	378.7	378.7	378.7	377.1	375.8	365.7	356.2	343.3	332.4	321.6
4800	378.7	378.7	378.7	378.7	378.7	378.7	372.6	362.9	349.8	338.7	327.7
5000	378.7	378.7	378.7	378.7	378.7	378.7	378.7	369.4	356.1	344.8	333.6
5200	378.7	378.7	378.7	378.7	378.7	378.7	378.7	375.7	362.1	350.7	339.3
5400	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	368.0	356.4	344.9
5600	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	373.6	361.9	350.2
CLIMB LIMIT WT (1000 KG)	335.7	335.5	335.4	335.2	335.1	334.9	322.6	310.6	294.2	280.3	266.6

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.

With engine and wing anti-ice on, decrease field limit weight by 1350 kg and climb limit weight by 2100 kg.

Takeoff Field & Climb Limit Weights - Wet Runway

Flaps 15

4000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
2240	282.7	256.1	254.4	252.3	249.4	247.0	239.9	233.9	225.6	218.9	212.7
2400	292.6	265.0	263.3	261.1	258.2	255.7	248.3	242.1	233.5	226.5	220.1
2600	304.6	275.9	274.0	271.8	268.7	266.1	258.4	252.0	243.0	235.7	229.0
2800	317.3	287.4	285.5	283.2	280.0	277.3	269.3	262.6	253.3	245.7	238.7
3000	327.8	296.9	294.9	292.4	289.1	286.4	278.0	271.1	261.4	253.6	246.4
3200	338.0	305.9	303.9	301.4	297.9	295.1	286.5	279.3	269.3	261.2	253.7
3400	347.7	314.7	312.6	310.0	306.4	303.4	294.6	287.2	276.8	268.5	260.8
3600	357.1	323.1	320.9	318.2	314.6	311.5	302.4	294.8	284.2	275.6	267.6
3800	366.1	331.1	328.9	326.1	322.4	319.3	309.9	302.1	291.1	282.3	274.1
4000	374.7	338.9	336.6	333.8	330.0	326.7	317.1	309.1	297.9	288.9	280.5
4200	378.7	346.4	344.1	341.2	337.3	334.0	324.2	315.9	304.5	295.2	286.7
4400	378.7	353.7	351.3	348.4	344.4	341.0	331.0	322.6	310.9	301.5	292.7
4600	378.7	360.8	358.3	355.3	351.3	347.8	337.6	329.0	317.1	307.5	298.6
4800	378.7	367.6	365.1	362.1	357.9	354.4	344.0	335.3	323.1	313.3	304.2
5000	378.7	374.2	371.7	368.5	364.3	360.8	350.2	341.3	329.0	319.0	309.8
5200	378.7	378.7	378.0	374.8	370.5	366.9	356.2	347.2	334.6	324.5	315.1
5400	378.7	378.7	378.7	378.7	376.5	372.8	361.9	352.8	340.1	329.8	320.3
5600	378.7	378.7	378.7	378.7	378.7	378.5	367.5	358.2	345.4	334.9	325.3
CLIMB LIMIT WT (1000 KG)	317.5	317.3	317.2	317.1	313.2	309.7	297.2	286.7	271.5	259.0	248.1

6000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
2240	264.1	239.3	237.7	233.9	230.3	227.6	221.4	216.2	209.0	203.1	197.3
2400	273.4	247.7	246.0	242.1	238.4	235.5	229.1	223.7	216.2	210.1	204.1
2600	284.5	257.7	256.0	251.9	248.0	245.1	238.4	232.8	225.0	218.6	212.4
2800	296.4	268.6	266.8	262.5	258.5	255.4	248.5	242.7	234.5	227.9	221.5
3000	306.2	277.3	275.5	271.1	266.9	263.7	256.5	250.5	242.0	235.1	228.5
3200	315.6	285.7	283.8	279.2	274.9	271.6	264.2	257.9	249.2	242.1	235.2
3400	324.6	293.8	291.8	287.1	282.7	279.3	271.6	265.1	256.1	248.8	241.6
3600	333.3	301.6	299.6	294.7	290.1	286.6	278.7	272.1	262.8	255.2	247.9
3800	341.7	309.1	307.0	302.0	297.3	293.7	285.6	278.8	269.3	261.5	253.9
4000	349.7	316.3	314.1	309.1	304.2	300.5	292.2	285.2	275.5	267.5	259.8
4200	357.5	323.3	321.1	315.9	310.9	307.2	298.7	291.5	281.6	273.4	265.5
4400	365.0	330.1	327.9	322.5	317.5	313.6	304.9	297.7	287.5	279.1	271.1
4600	372.3	336.7	334.4	329.0	323.8	319.9	311.0	303.6	293.2	284.7	276.5
4800	378.7	343.1	340.8	335.2	330.0	326.0	317.0	309.4	298.8	290.1	281.8
5000	378.7	349.3	346.9	341.3	335.9	331.9	322.7	315.0	304.2	295.4	286.9
5200	378.7	355.2	352.8	347.1	341.7	337.6	328.2	320.4	309.5	300.6	291.9
5400	378.7	361.0	358.5	352.8	347.2	343.1	333.6	325.7	314.6	305.5	296.7
5600	378.7	366.5	364.1	358.2	352.6	348.4	338.8	330.8	319.5	310.3	301.5
CLIMB LIMIT WT (1000 KG)	297.9	297.9	297.8	293.5	287.5	282.8	272.4	263.5	250.7	240.1	230.1

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.
With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.
With engine and wing anti-ice on, decrease field limit weight by 1350 kg and climb limit weight by 2100 kg.

Takeoff Field & Climb Limit Weights - Wet Runway**Flaps 15****8000 FT Pressure Altitude**

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (°C)										
	-40	14	18	23	26	28	33	37	42	46	50
2240	243.6	220.7	218.0	213.0	209.4	207.1	201.5	196.4	189.5	184.2	179.0
2400	252.2	228.4	225.6	220.4	216.7	214.3	208.5	203.1	196.1	190.5	185.1
2600	262.4	237.7	234.8	229.3	225.4	223.0	216.9	211.4	204.0	198.2	192.6
2800	273.5	247.7	244.7	239.0	235.0	232.5	226.2	220.4	212.7	206.7	200.8
3000	282.4	255.7	252.6	246.7	242.5	239.9	233.4	227.4	219.4	213.2	207.1
3200	291.0	263.3	260.1	254.0	249.7	247.0	240.2	234.0	225.8	219.4	213.1
3400	299.2	270.7	267.4	261.1	256.7	253.8	246.9	240.5	232.0	225.3	218.8
3600	307.2	277.8	274.4	267.9	263.4	260.5	253.3	246.7	237.9	231.1	224.4
3800	314.8	284.7	281.1	274.5	269.8	266.8	259.5	252.7	243.7	236.7	229.8
4000	322.2	291.3	287.7	280.8	276.1	273.0	265.5	258.5	249.3	242.1	235.1
4200	329.3	297.7	294.0	287.0	282.1	279.0	271.3	264.2	254.8	247.4	240.2
4400	336.2	304.0	300.2	293.1	288.1	284.9	277.0	269.7	260.1	252.6	245.2
4600	342.9	310.0	306.2	298.9	293.8	290.6	282.5	275.1	265.3	257.7	250.2
4800	349.4	315.9	312.0	304.6	299.4	296.1	287.9	280.4	270.4	262.6	255.0
5000	355.7	321.7	317.6	310.1	304.9	301.5	293.2	285.5	275.3	267.4	259.6
5200	361.8	327.2	323.1	315.5	310.1	306.7	298.2	290.5	280.2	272.1	264.2
5400	367.6	332.5	328.4	320.7	315.2	311.8	303.2	295.3	284.8	276.7	268.7
5600	373.3	337.7	333.5	325.7	320.2	316.7	308.0	300.0	289.4	281.1	273.0
CLIMB LIMIT WT (1000 KG)	273.7	273.7	270.6	262.7	256.7	253.2	243.8	234.7	222.5	213.2	204.0

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1700 kg.

With engine and wing anti-ice on, decrease field limit weight by 1350 kg and climb limit weight by 2100 kg.

Takeoff Obstacle Limit Weight
Flaps 15

Sea Level, 33°C & Below, Zero Wind

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or Auto

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	294.9	319.3	340.7	356.6	367.3						
20	274.3	297.3	315.6	330.9	344.0	354.2	361.2				
40	253.3	275.8	293.8	308.9	321.8	332.6	341.8	349.3	355.0	359.5	363.5
60	237.0	258.5	277.5	293.0	305.8	316.6	325.7	333.6	340.5	346.5	351.3
80		245.1	263.8	279.6	292.7	303.5	312.9	320.9	328.0	334.2	339.6
100		233.8	252.2	267.8	281.2	292.3	301.8	310.1	317.3	323.7	329.3
120		224.0	242.0	257.4	270.8	282.3	292.0	300.5	307.9	314.5	320.3
140		215.2	232.9	248.2	261.4	273.0	283.1	291.7	299.3	306.1	312.1
160			224.7	239.8	253.0	264.6	274.7	283.7	291.5	298.4	304.6
180			217.2	232.2	245.3	256.8	267.0	276.1	284.1	291.2	297.5
200			210.4	225.1	238.1	249.6	259.9	269.0	277.2	284.5	291.0
220			204.0	218.6	231.5	243.0	253.2	262.4	270.6	278.1	284.7
240			198.2	212.6	225.4	236.8	247.0	256.2	264.5	272.0	278.8
260				206.9	219.6	231.0	241.1	250.3	258.7	266.2	273.1
280				201.6	214.2	225.5	235.6	244.8	253.2	260.8	267.7
300				196.7	209.1	220.3	230.4	239.6	248.0	255.6	262.5

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustment

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)						
	160	200	240	280	320	360	400
33 & BELOW	0	0	0	0	0	0	0
34	-1.1	-1.3	-1.6	-1.8	-2.1	-2.4	-2.6
36	-4.1	-5.1	-6.1	-7.1	-8.1	-9.2	-10.2
38	-7.1	-8.8	-10.6	-12.4	-14.2	-15.9	-17.7
40	-10.1	-12.6	-15.1	-17.7	-20.2	-22.7	-25.3
42	-13.4	-16.7	-20.1	-23.4	-26.7	-30.0	-33.3
44	-16.8	-20.9	-25.0	-29.1	-33.2	-37.3	-41.4
46	-20.1	-25.0	-29.9	-34.8	-39.6	-44.5	-49.4
48	-23.4	-29.1	-34.8	-40.4	-46.1	-51.8	-57.5
50	-26.8	-33.2	-39.7	-46.1	-52.6	-59.1	-65.5

Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	160	200	240	280	320	360	400
S.L. & BELOW	0	0	0	0	0	0	0
1000	-6.9	-8.3	-9.7	-11.1	-12.5	-13.9	-15.3
2000	-13.9	-16.7	-19.4	-22.2	-25.0	-27.8	-30.5
3000	-19.9	-24.1	-28.3	-32.5	-36.6	-40.8	-45.0
4000	-26.0	-31.6	-37.1	-42.7	-48.3	-53.9	-59.5
5000	-31.9	-38.8	-45.8	-52.7	-59.7	-66.7	-73.6
6000	-37.8	-46.1	-54.4	-62.8	-71.1	-79.4	-87.8
7000	-44.1	-54.1	-64.1	-74.2	-84.2	-94.2	-104.3
8000	-50.4	-62.1	-73.9	-85.6	-97.3	-109.0	-120.8

Takeoff Obstacle Limit Weight**Flaps 15****Wind Adjustment**

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	160	200	240	280	320	360	400
15 TW	-12.0	-18.7	-25.3	-32.0	-31.2	-30.4	-29.6
10 TW	-8.0	-12.4	-16.9	-21.3	-20.8	-20.3	-19.7
5 TW	-4.0	-6.2	-8.4	-10.7	-10.4	-10.1	-9.9
0	0	0	0	0	0	0	0
10 HW	4.5	4.0	3.6	3.2	2.7	2.3	1.8
20 HW	8.9	8.1	7.2	6.3	5.4	4.6	3.7
30 HW	13.7	12.4	11.0	9.6	8.2	6.8	5.5
40 HW	18.5	16.7	14.8	12.9	11.0	9.1	7.2

With engine bleed for packs off, increase weight by 900 kg.

With engine and wing anti-ice on, decrease weight by 2250 kg.

Tire Speed Limit**Flaps 15**

AIRPORT OAT		TIRE SPEED LIMIT WEIGHT (1000 KG)				
		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	378.7	359.0	330.4	305.8	283.4
52	126	378.7	361.0	332.4	307.5	285.0
50	122	378.7	363.0	334.5	309.3	286.6
48	118	378.7	365.0	336.6	311.1	288.3
46	115	378.7	367.0	338.7	312.9	289.9
44	111	378.7	369.0	340.9	314.7	291.6
42	108	378.7	371.1	343.4	316.5	293.3
40	104	378.7	373.2	346.1	318.3	295.1
38	100	378.7	375.3	348.8	320.2	296.8
36	97	378.7	377.5	350.8	322.1	298.6
34	93	378.7	378.7	352.9	324.1	300.4
32	90	378.7	378.7	354.7	325.9	302.1
30	86	378.7	378.7	356.6	327.7	303.7
28	82	378.7	378.7	358.5	329.6	305.4
26	79	378.7	378.7	360.5	331.6	307.1
24	75	378.7	378.7	362.5	333.6	308.8
22	72	378.7	378.7	364.7	335.8	310.5
20	68	378.7	378.7	366.9	338.0	312.3
18	64	378.7	378.7	369.1	340.2	314.1
16	61	378.7	378.7	371.4	342.9	316.0
14	57	378.7	378.7	373.7	345.8	317.9
12	54	378.7	378.7	376.0	348.7	319.9
10	50	378.7	378.7	378.3	350.9	322.0
-40	-40	378.7	378.7	378.7	378.7	378.7

Increase tire speed limit weight by 2300 kg per knot headwind.

Decrease tire speed limit weight by 5300 kg per knot tailwind.

Takeoff Speeds - Dry Runway
Flaps 15
V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	KIAS		
	V1	VR	V2
360	169	176	180
340	164	170	176
320	158	165	171
300	152	158	166
280	146	152	161
260	139	145	156
240	131	138	151
220	122	131	145
200	113	123	139
180	102	115	133
160	91	106	126
140	83	97	119

Check V1(MCG), Minimum VR, Minimum V2, and Minimum Takeoff Weight.

V1, VR, V2 Adjustments*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
°C	°F	-2	0	2	4	6	8	-2	0	2	4	6	8	-2	0	2	4	6	8
70	158	12	14					6	7					-3	-3				
60	140	8	10	12	15			4	5	6	7			-2	-2	-3	-3		
50	122	4	5	8	10	13	17	2	3	4	6	7	8	-1	-1	-2	-2	-3	-4
40	104	1	2	4	7	10	14	0	1	3	4	5	7	0	-1	-1	-2	-2	-3
30	86	0	0	1	4	7	11	0	0	1	3	4	6	0	0	0	-1	-1	-2
20	68	0	0	1	3	5	9	0	0	1	2	3	5	0	0	0	-1	-1	-2
-60	-76	0	0	1	3	5	7	0	0	1	2	3	4	0	0	0	-1	-1	-1

Slope and Wind V1 Adjustments*

WEIGHT (1000 KG)	SLOPE (%)						WIND (KTS)							
	-2	-1	0	1	2		-15	-10	-5	0	10	20	30	40
360	-4	-2	0	3	5		-3	-2	-1	0	1	2	3	3
340	-4	-2	0	3	5		-3	-2	-1	0	1	2	3	3
320	-3	-1	0	3	5		-3	-1	0	0	1	2	2	3
300	-3	-1	0	3	4		-2	-1	0	0	1	2	2	3
280	-3	-1	0	2	4		-2	-1	0	0	1	2	2	3
260	-2	-1	0	2	4		-2	-1	0	0	1	2	2	3
240	-2	-1	0	2	4		-1	-1	0	0	1	2	2	3
220	-2	0	0	2	4		-1	0	0	0	1	2	2	3
200	-2	0	0	2	4		-1	0	0	0	1	2	3	3
180	-1	0	0	3	4		-1	0	1	0	1	2	3	3
160	-1	0	0	3	4		-1	0	1	0	1	2	3	3
140	-1	0	0	3	4		-1	0	1	0	1	3	3	4

*V1 not to exceed VR

Takeoff Speeds - Dry Runway

Flaps 15

V1(MCG), Minimum VR

Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		-2000		0		2000		4000		6000		8000	
°C	°F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	125	127	121	124	119	122	117	120				
50	122	129	131	125	128	119	122	117	120	115	118	111	114
40	104	136	138	133	135	127	130	122	125	117	120	111	114
30	86	138	140	138	140	133	136	128	130	122	125	115	118
20	68	139	140	138	140	134	137	131	133	126	129	119	123
-60	-76	140	140	139	140	136	137	132	133	127	129	121	124

Minimum V2

Max Takeoff Thrust

PRESSURE ALTITUDE (FT)	-2000	0	2000	4000	6000	8000
SPEED (KIAS)	135	133	131	128	126	123

Takeoff Speeds - Wet Runway
Flaps 15
V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	KIAS		
	V1	VR	V2
360	161	176	180
340	155	170	176
320	148	165	171
300	141	158	166
280	134	152	161
260	126	145	156
240	119	138	151
220	110	131	145
200	101	123	139
180	91	115	133
160	81	106	126
140	71	97	119

Check V1(MCG), Minimum VR, Minimum V2, and Minimum Takeoff Weight.

V1, VR, V2 Adjustment*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
°C	°F	-2	0	2	4	6	8	-2	0	2	4	6	8	-2	0	2	4	6	8
70	158	14	16					6	7					-3	-3				
60	140	9	11	14	16			4	5	6	7			-2	-2	-3	-3		
50	122	5	6	9	11	14	17	2	3	4	6	7	8	-1	-1	-2	-2	-3	-4
40	104	1	2	5	8	10	14	0	1	3	4	5	7	0	-1	-1	-2	-2	-3
30	86	0	0	2	5	7	11	0	0	1	3	4	6	0	0	0	-1	-1	-2
20	68	0	0	1	3	5	9	0	0	1	2	3	5	0	0	0	-1	-1	-2
-60	-76	0	0	1	3	5	8	0	0	1	2	3	4	0	0	0	-1	-1	-1

Slope and Wind V1 Adjustment*

WEIGHT (1000 KG)	SLOPE (%)					WIND (KTS)								
	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40	
360	-6	-3	0	3	6	-4	-3	-1	0	1	2	3	4	
340	-6	-3	0	3	6	-4	-3	-1	0	1	2	3	4	
320	-6	-3	0	3	5	-5	-3	-2	0	1	2	3	4	
300	-5	-3	0	3	5	-5	-3	-2	0	1	2	3	4	
280	-5	-2	0	3	5	-5	-3	-2	0	1	2	3	4	
260	-5	-2	0	3	5	-5	-3	-1	0	1	2	3	4	
240	-4	-2	0	3	5	-5	-3	-1	0	1	3	4	5	
220	-4	-1	0	3	5	-4	-3	-1	0	1	3	4	5	
200	-3	-1	0	3	5	-4	-2	-1	0	1	3	4	5	
180	-2	0	0	3	5	-3	-2	0	0	2	3	4	5	
160	-2	0	0	4	5	-3	-1	0	0	2	4	5	6	
140	-1	0	0	4	6	-2	0	0	0	2	4	5	6	

*V1 not to exceed VR

Takeoff Speeds - Wet Runway

Flaps 15

V1(MCG), Minimum VR

Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		-2000		0		2000		4000		6000		8000	
°C	°F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	125	127	121	124	119	122	117	120				
50	122	129	131	125	128	119	122	117	120	115	118	111	114
40	104	136	138	133	135	127	130	122	125	117	120	111	114
30	86	138	140	138	140	133	136	128	130	122	125	115	118
20	68	139	140	138	140	134	137	131	133	126	129	119	123
-60	-76	140	140	139	140	136	137	132	133	127	129	121	124

Minimum V2

Max Takeoff Thrust

PRESSURE ALTITUDE (FT)	-2000	0	2000	4000	6000	8000
SPEED (KIAS)	135	133	131	128	126	123

Intentionally
Blank

Performance Dispatch**Chapter PD****Enroute****Section 41****Long Range Cruise Maximum Operating Altitude****Max Climb Thrust****ISA + 10°C and Below**

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27300	5	30400	28800	27200
350	27900	4	31000	29400	27800
340	28500	3	31700	30000	28500
330	29200	1	32200	30500	29000
320	29900	0	32700	31000	29500
310	30600	-2	33200	31600	30000
300	31300	-4	33700	32100	30600
290	32000	-5	34300	32700	31200
280	32800	-7	34900	33300	31800
270	33600	-9	35500	33900	32400
260	34400	-11	36100	34500	33100
250	35200	-12	36800	35200	33800
240	36000	-14	37500	35900	34500
230	36900	-15	38200	36600	35200
220	37800	-15	39000	37400	36000
210	38800	-15	39800	38200	36800
200	39800	-15	40600	39000	37700
190	40900	-15	41500	39900	38600
180	42000	-15	42500	40900	39600
170	43100	-15	43100	42100	40800
160	43100	-15	43100	43100	42000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27300	11	30400	28800	27200
350	27900	10	31000	29400	27800
340	28500	8	31700	30000	28500
330	29200	7	32200	30500	29000
320	29900	5	32700	31000	29500
310	30600	4	33200	31600	30000
300	31300	2	33700	32100	30600
290	32000	0	34300	32700	31200
280	32800	-1	34900	33300	31800
270	33600	-3	35500	33900	32400
260	34400	-5	36100	34500	33100
250	35200	-7	36800	35200	33800
240	36000	-9	37500	35900	34500
230	36900	-9	38200	36600	35200
220	37800	-9	39000	37400	36000
210	38800	-9	39800	38200	36800
200	39800	-9	40600	39000	37700
190	40900	-9	41500	39900	38600
180	42000	-9	42500	40900	39600
170	43100	-9	43100	42100	40800
160	43100	-9	43100	43100	42000

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27300	17	30400	28800	27200
350	27900	15	31000	29400	27800
340	28500	14	31700	30000	28500
330	29200	12	32200	30500	29000
320	29900	11	32700	31000	29500
310	30600	9	33200	31600	30000
300	31300	8	33700	32100	30600
290	32000	6	34300	32700	31200
280	32800	4	34900	33300	31800
270	33600	3	35500	33900	32400
260	34400	1	36100	34500	33100
250	35200	-1	36800	35200	33800
240	36000	-3	37500	35900	34500
230	36900	-3	38200	36600	35200
220	37800	-3	39000	37400	36000
210	38800	-3	39800	38200	36800
200	39800	-3	40600	39000	37700
190	40900	-3	41500	39900	38600
180	42000	-3	42500	40900	39600
170	43100	-3	43100	42100	40800
160	43100	-3	43100	43100	42000

Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
665	625	588	556	526	500	479	458	440	423	407
1320	1242	1171	1108	1052	1000	958	919	883	850	820
1973	1857	1752	1660	1576	1500	1438	1381	1327	1278	1233
2623	2471	2333	2211	2101	2000	1918	1842	1771	1706	1647
3271	3083	2913	2761	2625	2500	2398	2304	2216	2135	2061
3915	3693	3491	3311	3149	3000	2879	2766	2661	2564	2475
4556	4301	4068	3860	3672	3500	3359	3228	3106	2993	2890
5195	4906	4643	4407	4195	4000	3840	3690	3551	3422	3304
5831	5510	5216	4954	4717	4500	4320	4152	3995	3851	3719
6465	6112	5788	5500	5240	5000	4800	4613	4440	4280	4133
7096	6712	6360	6046	5762	5500	5280	5075	4885	4709	4547
7726	7311	6931	6591	6283	6000	5761	5537	5329	5137	4961
8354	7909	7501	7136	6805	6500	6240	5998	5773	5565	5375
8981	8506	8070	7680	7326	7000	6720	6460	6217	5993	5788
9607	9102	8639	8224	7847	7500	7201	6921	6661	6421	6201
10233	9698	9208	8768	8368	8000	7681	7382	7105	6849	6614
10858	10294	9777	9312	8890	8500	8161	7844	7549	7277	7028
11483	10890	10345	9856	9411	9000	8641	8305	7993	7705	7441
12108	11486	10914	10399	9932	9500	9121	8766	8437	8133	7854
12732	12081	11482	10943	10453	10000	9601	9228	8881	8561	8267

Reference Fuel and Time Required

AIR DIST(NM)	PRESSURE ALTITUDE (1000 FT)									
	27		29		31		33		35	
	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)	FUEL 1000 KG	TIME (HR:MIN)
500	8.6	1:19	8.4	1:18	8.4	1:17	8.3	1:15	8.2	1:14
1000	15.8	2:30	15.5	2:28	15.2	2:24	14.9	2:20	14.6	2:17
1500	23.2	3:40	22.7	3:36	22.2	3:29	21.8	3:23	21.3	3:20
2000	30.7	4:50	29.9	4:43	29.3	4:34	28.6	4:27	27.9	4:23
2500	38.4	5:58	37.4	5:49	36.6	5:38	35.7	5:29	34.9	5:25
3000	46.1	7:06	45.0	6:55	43.9	6:42	42.8	6:32	41.8	6:27
3500	54.2	8:11	52.8	7:58	51.5	7:44	50.2	7:34	49.1	7:29
4000	62.3	9:17	60.6	9:02	59.1	8:47	57.6	8:36	56.4	8:31
4500	70.7	10:21	68.8	10:04	67.0	9:48	65.3	9:38	64.0	9:34
5000	79.1	11:25	76.9	11:07	74.9	10:50	73.1	10:39	71.7	10:36
5500	87.8	12:27	85.4	12:08	83.1	11:51	81.2	11:41	79.9	11:38
6000	96.6	13:29	93.8	13:10	91.3	12:53	89.3	12:42	88.1	12:40
6500	105.7	14:30	102.7	14:11	100.0	13:54	97.9	13:44	97.0	13:43
7000	114.8	15:32	111.5	15:11	108.6	14:55	106.5	14:46	105.8	14:46
7500	124.3	16:32	120.7	16:12	117.8	15:56	115.8	15:48	115.6	15:49
8000	133.8	17:33	130.0	17:13	126.9	16:57	125.1	16:50	125.3	16:52
8500	143.9	18:33	139.8	18:13	136.7	17:58	135.3	17:52		
9000	153.9	19:33	149.7	19:14	146.5	19:00	145.5	18:54		
9500	164.4	20:33	160.1	20:15	157.2	20:01	156.8	19:57		
10000	175.0	21:33	170.5	21:15	167.9	21:03	168.0	21:00		

**Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	160	180	200	220	240
20	-2.1	-1.1	0.0	1.2	2.7
30	-3.1	-1.6	0.0	1.9	4.3
40	-4.2	-2.1	0.0	2.7	6.2
50	-5.3	-2.7	0.0	3.6	8.3
60	-6.4	-3.2	0.0	4.7	10.7
70	-7.5	-3.8	0.0	5.9	13.4
80	-8.7	-4.4	0.0	7.2	16.3
90	-9.8	-5.0	0.0	8.6	19.5
100	-11.0	-5.6	0.0	10.2	23.0
110	-12.2	-6.2	0.0	11.9	26.7
120	-13.4	-6.8	0.0	13.7	30.7
130	-14.6	-7.5	0.0	15.7	35.0
140	-15.9	-8.1	0.0	17.8	39.5
150	-17.1	-8.8	0.0	20.0	44.3
160	-18.4	-9.5	0.0	22.3	49.4
170	-19.7	-10.2	0.0	24.8	54.7
180	-21.0	-10.9	0.0	27.3	60.3

Based on 310/.84 climb, Long Range Cruise and .84/310/250 descent.

**Long Range Cruise Step Climb Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1292	1221	1157	1099	1047	1000	957	917	881	847	816
1923	1820	1728	1645	1569	1500	1437	1379	1325	1276	1229
2554	2420	2299	2190	2091	2000	1917	1840	1770	1704	1643
3185	3020	2871	2735	2612	2500	2397	2302	2214	2133	2057
3816	3619	3442	3281	3134	3000	2877	2764	2659	2562	2472
4446	4218	4012	3826	3656	3500	3357	3225	3104	2991	2886
5077	4817	4583	4371	4177	4000	3837	3687	3548	3420	3300
5707	5416	5154	4916	4699	4500	4317	4149	3993	3849	3715
6336	6015	5724	5461	5220	5000	4798	4611	4438	4278	4129
6966	6613	6295	6006	5742	5500	5278	5073	4883	4707	4544
7595	7212	6865	6550	6263	6000	5758	5535	5329	5137	4959
8224	7810	7435	7095	6784	6500	6238	5997	5774	5566	5373
8853	8408	8005	7640	7306	7000	6719	6459	6219	5996	5788
9481	9006	8575	8184	7827	7500	7199	6921	6664	6426	6204
10110	9603	9145	8729	8348	8000	7679	7384	7110	6855	6619
10738	10201	9715	9273	8870	8500	8160	7846	7555	7285	7034
11366	10798	10284	9817	9391	9000	8640	8308	8001	7715	7449
11993	11395	10854	10362	9912	9500	9121	8771	8446	8145	7865
12621	11992	11423	10906	10433	10000	9601	9233	8892	8575	8280

Trip Fuel and Time Required

AIR DIST (NM)	TRIP FUEL (1000 KG)									TIME (HRS:MIN)
	LANDING WEIGHT (1000 KG)									
	150	160	170	180	190	200	210	220	230	
1000	11.8	12.2	12.7	13.3	13.8	14.5	14.9	15.5	16.0	2:16
1500	16.9	17.6	18.3	19.1	20.0	20.9	21.6	22.4	23.3	3:18
2000	22.1	23.0	24.1	25.2	26.4	27.5	28.5	29.6	30.9	4:20
2500	27.4	28.6	29.9	31.4	32.9	34.3	35.6	37.1	38.6	5:23
3000	32.9	34.4	36.0	37.8	39.5	41.3	42.9	44.7	46.5	6:25
3500	38.5	40.3	42.3	44.3	46.4	48.4	50.4	52.5	54.6	7:27
4000	44.2	46.3	48.7	51.0	53.4	55.8	58.1	60.5	63.0	8:29
4500	50.1	52.6	55.2	57.9	60.6	63.4	66.0	68.8	71.5	9:31
5000	56.2	59.0	61.9	64.9	68.1	71.2	74.1	77.2	80.3	10:33
5500	62.5	65.6	68.8	72.2	75.7	79.2	82.5	85.9	89.4	11:34
6000	68.9	72.3	75.9	79.7	83.6	87.4	91.0	94.8	98.8	12:36
6500	75.4	79.2	83.2	87.4	91.6	95.8	99.8	104.1	108.5	13:38
7000	82.1	86.3	90.8	95.3	99.9	104.4	108.9	113.6	118.4	14:39
7500	89.0	93.6	98.5	103.4	108.3	113.3	118.2	123.4	128.6	15:40
8000	96.1	101.2	106.4	111.7	117.0	122.5	127.9	133.4	139.0	16:42
8500	103.4	108.9	114.5	120.2	126.1	132.0	137.8	143.8	149.8	17:43
9000	111.0	116.8	122.8	129.0	135.3	141.7	148.0	154.4	160.9	18:44
9500	118.7	124.9	131.4	138.0	144.9	151.7	158.4	165.3	172.2	19:45
10000	126.6	133.3	140.2	147.4	154.7	162.0	169.2	176.5	183.9	20:46

Based on 310/.84 climb, Long Range Cruise and .84/310/250 descent.

Valid for all pressure altitudes with 4000 ft step climb to 2000 ft above optimum altitude.

Short Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
95	81	70	62	55	50	46	42	39	36	34
161	143	129	118	108	100	93	87	82	77	73
225	205	187	173	161	150	141	132	125	118	113
288	264	245	228	213	200	189	178	169	161	153
349	323	301	282	265	250	237	225	214	204	195
410	382	357	336	317	300	285	271	258	247	237
471	440	414	390	369	350	333	317	303	290	279
532	499	470	444	421	400	381	364	348	334	320
595	559	527	499	473	450	429	410	393	376	362
660	621	585	554	526	500	477	456	436	419	402

Trip Fuel and Time

AIR DIST (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		160	180	200	220	240	
50	FUEL (1000 KG)	1.6	1.8	1.9	2.0	2.1	0:14
	ALT (FT)	11000	9000	9000	7000	5000	
100	FUEL (1000 KG)	2.4	2.6	2.7	2.8	3.0	0:23
	ALT (FT)	15000	13000	13000	13000	13000	
150	FUEL (1000 KG)	3.2	3.4	3.5	3.7	3.9	0:30
	ALT (FT)	21000	21000	21000	21000	21000	
200	FUEL (1000 KG)	3.8	4.1	4.3	4.5	4.8	0:37
	ALT (FT)	27000	27000	27000	25000	25000	
250	FUEL (1000 KG)	4.4	4.7	5.0	5.3	5.6	0:43
	ALT (FT)	37000	31000	29000	29000	29000	
300	FUEL (1000 KG)	5.0	5.3	5.6	6.0	6.3	0:48
	ALT (FT)	41000	39000	37000	35000	33000	
350	FUEL (1000 KG)	5.5	5.9	6.2	6.6	7.0	0:54
	ALT (FT)	43000	39000	37000	35000	35000	
400	FUEL (1000 KG)	6.0	6.4	6.9	7.3	7.8	1:00
	ALT (FT)	43000	39000	37000	37000	35000	
450	FUEL (1000 KG)	6.5	7.0	7.5	8.0	8.5	1:06
	ALT (FT)	43000	41000	39000	37000	35000	
500	FUEL (1000 KG)	7.0	7.6	8.1	8.7	9.2	1:13
	ALT (FT)	43000	41000	39000	37000	35000	

Holding Planning
Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)									
	PRESSURE ALTITUDE (FT)									
	1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
360	9310	9240	9140	9180	9690	10040	10600			
340	8810	8730	8620	8620	9080	9360	9780			
320	8250	8160	8050	8030	8430	8630	8950	9950		
300	7720	7630	7510	7480	7600	7980	8260	8850		
280	7250	7150	7030	6970	7000	7380	7620	8060		
260	6790	6670	6530	6470	6470	6800	6990	7250	8510	
240	6350	6220	6060	5980	5970	6030	6380	6590	7270	
220	5940	5790	5610	5530	5490	5490	5770	5960	6450	7070
200	5590	5430	5230	5140	5070	5040	5150	5350	5660	6020
180	5270	5100	4900	4800	4710	4760	4650	4750	5000	5210
160	5120	4940	4750	4610	4500	4440	4330	4310	4460	4560

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
360	10290	10260	10210	10300	10530
340	9680	9630	9570	9620	9830
320	9080	9030	8960	8980	9160
300	8510	8450	8370	8380	8520
280	7940	7870	7770	7770	7860
260	7390	7300	7190	7190	7240
240	6860	6740	6630	6600	6620
220	6340	6200	6070	6010	6020
200	5880	5720	5550	5470	5430
180	5480	5300	5110	5020	4960
160	5260	5080	4860	4760	4660

These tables include 5% additional fuel for holding in a racetrack pattern.

Crew Oxygen Requirements

Required Pressure (PSI) for Three 115 Cubic Ft. Cylinders

Table 1 - Minimum Dispatch Pressure Using Normal Oxygen Flow

NUMBER OF CREW USING OXYGEN	TOTAL TIME ON DILUTED OXYGEN (MINUTES)				
	120	180	207	240	300
2	390	520	570	650	770
3	530	720	810	920	1110
4	680	930	1050	1190	1440

For more extensive than normal crew usage, add 0.5 psi/person/minute.

Table 2 - Minimum Dispatch Pressure Using 100% Oxygen Flow

NUMBER OF CREW USING OXYGEN	TOTAL TIME ON 100% OXYGEN (MINUTES)				
	120	180	207	240	300
2	440	590	650	740	880
3	610	830	930	1050	1280
4	770	1070	1210	1370	1670

For more extensive than normal crew usage, add 2.7 psi/person/minute.

Table 3 - Temperature Corrections

CYLINDER PRESSURE AT 21°C (PSI)	PRESSURE CORRECTION FOR EACH 5°C ABOVE/BELOW 21°C (PSI)
400	+7/-7
600	+11/-11
800	+14/-14
1000	+17/-17
1200	+21/-21
1400	+24/-24
1600	+28/-28
1800	+31/-31
2000	+34/-34

Maximum cylinder pressure = 1850 PSI at 21°C. For maximum cylinder pressure at hotter or colder temperatures, add or subtract 32 PSI per 5°C, respectively.

ENGINE INOP
MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
32	166.0	164.5	161.0
30	183.7	181.5	175.5
28	197.9	193.2	185.8
26	213.1	207.2	199.2
24	229.4	222.1	213.9
22	246.8	238.7	230.1
20	271.4	264.3	254.0
18	293.8	284.5	273.3
16	318.2	306.9	294.9
14	339.7	326.4	313.5
12	361.3	347.4	334.2

Anti-Ice Adjustments

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG)								
	PRESSURE ALTITUDE (1000 FT)								
	14	16	18	20	22	24	26	28	30
ENGINE ONLY	-0.7	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINE AND WING	-2.7	-2.0	-1.6	-1.2	-1.3	-1.4	-1.5	-1.5	-1.5

ALL ENGINES

**Long Range Cruise Critical Fuel Reserves
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
286	263	244	227	213	200	189	179	170	161	154
571	526	487	454	425	400	377	357	339	323	308
856	789	731	681	638	600	566	536	509	484	462
1141	1051	975	909	851	800	755	715	678	646	616
1426	1314	1218	1136	1064	1000	944	893	848	807	770
1711	1577	1462	1363	1276	1200	1132	1072	1018	969	924
1996	1840	1706	1590	1489	1400	1321	1251	1187	1130	1078
2282	2102	1949	1817	1702	1600	1510	1429	1357	1291	1232
2567	2365	2193	2044	1914	1800	1699	1608	1526	1453	1386

Critical Fuel (1000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)										
	160	180	200	220	240	260	280	300	320	340	360
200	4.8	4.9	5.0	5.2	5.4	5.6	5.8	6.0	6.2	6.5	6.7
300	6.7	6.7	6.9	7.2	7.5	7.7	8.0	8.3	8.6	8.9	9.3
400	8.5	8.6	8.8	9.2	9.5	9.9	10.2	10.6	11.0	11.4	11.8
500	10.4	10.4	10.8	11.2	11.6	12.0	12.5	12.9	13.3	13.9	14.4
600	12.2	12.2	12.7	13.2	13.7	14.2	14.7	15.2	15.7	16.3	16.9
700	14.0	14.1	14.6	15.1	15.7	16.3	16.9	17.5	18.1	18.8	19.5
800	15.9	15.9	16.5	17.1	17.8	18.5	19.1	19.8	20.4	21.2	22.0
900	17.7	17.8	18.4	19.1	19.9	20.6	21.4	22.1	22.8	23.7	24.5
1000	19.6	19.6	20.3	21.1	21.9	22.8	23.6	24.3	25.1	26.0	27.0
1100	21.4	21.5	22.2	23.1	23.9	24.8	25.7	26.5	27.4	28.4	29.5
1200	23.3	23.3	24.1	25.0	25.9	26.9	27.8	28.8	29.7	30.8	31.9
1300	25.1	25.2	26.0	26.9	27.9	29.0	30.0	31.0	32.0	33.2	34.4
1400	27.0	27.0	27.8	28.8	29.9	31.0	32.1	33.2	34.3	35.5	36.8
1500	28.8	28.8	29.6	30.7	31.9	33.1	34.3	35.4	36.6	37.9	39.3
1600	30.7	30.7	31.5	32.7	33.9	35.2	36.4	37.7	38.9	40.3	41.8
1700	32.5	32.5	33.3	34.6	35.9	37.2	38.6	39.9	41.2	42.6	44.2
1800	34.3	34.4	35.2	36.5	37.9	39.3	40.7	42.1	43.5	44.9	46.5

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft, 15 minute hold at 1500 ft, one missed approach, approach and land. Includes 5% allowance for wind errors.
Increase fuel required 0.8% for each 10°C above ISA.
If icing conditions exist, increase fuel required by 7% to account for engine and wing anti-ice on (3%) and ice accumulation on unheated surfaces (4%).
Allowance for performance deterioration not included.
Compare the fuel required for all engine and engine inoperative critical fuel reserves, and use the higher of the two.

ENGINE INOP

Long Range Cruise Critical Fuel Reserves
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
287	264	245	228	213	200	189	178	169	161	153
577	530	490	456	426	400	377	356	338	321	306
866	795	735	684	639	600	565	534	507	482	459
1155	1061	981	912	852	800	754	712	675	642	612
1444	1326	1226	1140	1066	1000	942	890	844	803	765
1733	1592	1472	1368	1279	1200	1130	1069	1013	963	918
2022	1857	1717	1596	1492	1400	1319	1247	1182	1123	1071
2311	2123	1962	1825	1705	1600	1507	1425	1351	1284	1224
2600	2388	2208	2053	1918	1800	1696	1603	1519	1444	1376

Critical Fuel (1000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)										
	160	180	200	220	240	260	280	300	320	340	360
200	4.6	4.7	4.9	5.2	5.4	5.7	5.9	6.2	6.5	6.8	7.1
300	6.4	6.5	6.8	7.2	7.5	7.9	8.2	8.6	9.0	9.4	9.8
400	8.2	8.3	8.7	9.2	9.6	10.1	10.5	11.0	11.5	12.0	12.5
500	10.0	10.1	10.6	11.2	11.7	12.3	12.8	13.4	14.0	14.6	15.2
600	11.8	11.9	12.5	13.2	13.8	14.4	15.1	15.7	16.5	17.2	17.9
700	13.6	13.7	14.4	15.1	15.9	16.6	17.4	18.1	19.0	19.8	20.7
800	15.4	15.5	16.3	17.1	18.0	18.8	19.6	20.5	21.4	22.4	23.4
900	17.2	17.3	18.2	19.1	20.1	21.0	21.9	22.9	23.9	25.0	26.0
1000	19.0	19.1	20.1	21.1	22.2	23.2	24.2	25.2	26.3	27.5	28.6
1100	20.8	20.9	22.0	23.1	24.2	25.3	26.3	27.5	28.7	30.0	31.2
1200	22.6	22.7	23.8	25.0	26.2	27.4	28.5	29.8	31.1	32.5	33.8
1300	24.4	24.4	25.6	26.9	28.2	29.5	30.7	32.0	33.5	35.0	36.4
1400	26.2	26.2	27.4	28.8	30.2	31.6	32.9	34.3	35.8	37.5	39.1
1500	27.9	28.0	29.2	30.6	32.2	33.6	35.1	36.6	38.2	39.9	41.7
1600	29.7	29.8	31.0	32.5	34.2	35.7	37.3	38.9	40.6	42.4	44.2
1700	31.5	31.6	32.7	34.4	36.1	37.8	39.5	41.2	43.0	44.9	46.7
1800	33.3	33.4	34.5	36.3	38.1	39.9	41.7	43.4	45.3	47.2	49.2

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft, 15 minute hold at 1500 ft, one missed approach, approach and land. Includes APU fuel burn and 5% allowance for wind errors.

Increase fuel required 0.8% for each 10°C above ISA.

If icing conditions exist, increase fuel required by 9% to account for engine and wing anti-ice on (1%) and ice accumulation on unheated surfaces (8%).

Allowance for performance deterioration not included.

Compare the fuel required for all engine and engine inoperative critical fuel reserves, and use the higher of the two.

Intentionally
Blank

Performance Dispatch**Chapter PD****Landing****Section 42****Landing Field Limit Weight - Dry Runway****Flaps 30****Wind Corrected Field Length (M)**

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1400			1280	1400	1450	1520	1580	1640
1600	1300	1360	1460	1600	1670	1750	1820	1900
1800	1440	1520	1640	1800	1880	1980	2070	2170
2000	1580	1680	1820	2000	2090	2210	2310	2430
2200	1720	1840	2000	2200	2310	2430	2550	2690
2400	1860	2010	2180	2400	2520	2660	2800	2950
2600	2010	2170	2360	2600	2730	2890	3040	3210
2800	2150	2330	2540	2800	2940	3120	3290	3470
3000	2290	2490	2720	3000	3160	3350	3530	3740
3200	2430	2650	2900	3200	3370	3580	3770	4000
3400	2570	2810	3080	3400	3580	3800	4020	4260
3600	2710	2980	3260	3600	3790	4030	4260	4520
3800	2860	3140	3440	3800	4010	4260	4500	4780
4000	3000	3300	3620	4000	4220	4490	4750	5050
4200	3140	3460	3800	4200	4430	4720	4990	5310
4400	3280	3620	3980	4400	4650	4950	5230	5570

Field Limit Weight (1000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1400	188.7	176.8	166.1	155.9	
1600	227.3	213.3	200.0	187.5	175.6
1800	263.8	249.9	234.4	219.5	205.4
2000	293.0	277.5	265.6	252.5	236.4
2200	309.3	301.2	292.7	276.4	264.6
2400	322.0	313.1	305.0	296.9	287.0
2600	334.7	324.6	315.2	307.0	298.7
2800	345.8	336.1	325.8	316.1	307.8
3000	357.7	346.0	336.3	325.9	316.1
3200	369.1	356.7	345.3	335.3	324.9
3400	380.0	366.9	354.8	343.8	333.5
3600		376.4	363.8	352.1	341.5
3800		385.9	372.3	360.1	348.4
4000			380.5	367.6	355.9
4200			388.7	374.8	362.6
4400				381.7	369.0

With manual speedbrakes, decrease weight by 21450 kg.

With 1 brake deactivated, decrease weight by 20600 kg.

With 2 brakes deactivated, decrease weight by 41900 kg.

Landing Field Limit Weight - Wet Runway

Flaps 30

Wind Corrected Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
1400				1400	1450	1510	1560	1610
1600			1460	1600	1660	1740	1800	1870
1800	1460	1530	1640	1800	1870	1960	2050	2140
2000	1600	1690	1820	2000	2090	2190	2290	2400
2200	1750	1850	2000	2200	2300	2420	2540	2660
2400	1890	2010	2180	2400	2510	2650	2780	2920
2600	2030	2180	2360	2600	2730	2880	3020	3180
2800	2170	2340	2540	2800	2940	3110	3270	3450
3000	2310	2500	2720	3000	3150	3330	3510	3710
3200	2460	2660	2900	3200	3360	3560	3750	3970
3400	2600	2820	3080	3400	3580	3790	4000	4230
3600	2740	2980	3260	3600	3790	4020	4240	4490
3800	2880	3150	3440	3800	4000	4250	4480	4760
4000	3020	3310	3620	4000	4210	4480	4730	5020
4200	3160	3470	3800	4200	4430	4700	4970	5280
4400	3310	3630	3980	4400	4640	4930	5220	5540

Field Limit Weight (1000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1400	153.4				
1600	187.0	175.2	164.6	154.6	
1800	220.6	206.9	194.1	182.0	170.4
2000	253.4	238.7	223.8	209.7	196.3
2200	278.4	266.6	253.6	238.1	222.9
2400	300.4	291.1	275.9	263.7	250.0
2600	313.2	305.1	296.8	285.0	269.5
2800	324.2	315.0	306.8	298.7	289.3
3000	335.2	325.1	315.7	307.4	299.1
3200	344.9	335.1	324.9	315.4	307.0
3400	355.0	344.1	334.0	323.8	314.3
3600	365.2	353.0	342.5	332.1	321.8
3800	374.8	362.1	350.2	340.0	329.4
4000	384.2	370.6	358.4	346.6	336.7
4200		378.9	366.0	354.2	343.2
4400		387.1	373.4	361.1	349.4

With manual speedbrakes, decrease weight by 21450 kg.

With 1 brake deactivated, decrease weight by 20600 kg.

With 2 brakes deactivated, decrease weight by 41900 kg.

Landing Climb Limit Weight**Valid for approach with flaps 20 and landing with flaps 30**

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
54	129	297.3	279.1				
52	126	306.3	287.0				
50	122	315.2	294.5	269.7			
48	118	323.5	303.4	276.9			
46	115	331.8	312.4	284.1	259.6		
44	111	340.4	321.1	291.5	267.7		
42	108	349.8	329.0	299.1	275.0	251.6	
40	104	356.7	337.3	307.2	281.4	257.0	
38	100	363.8	347.0	316.0	287.8	262.8	233.8
36	97	366.6	354.0	323.2	293.4	269.2	238.4
34	93	366.8	360.8	330.4	299.7	274.4	243.0
32	90	367.1	363.3	337.6	306.4	278.7	247.1
30	86	367.3	363.4	344.5	312.9	282.9	250.9
28	82	367.6	363.6	350.2	318.7	287.3	254.6
26	79	367.9	363.7	350.4	322.6	292.2	258.2
24	75	368.1	363.9	350.5	326.0	297.0	263.1
22	72	368.4	364.0	350.5	327.4	300.3	268.1
20	68	368.6	364.1	350.6	327.5	302.5	272.4
18	64	368.9	364.3	350.7	327.6	304.7	275.2
16	61	369.2	364.4	350.8	327.6	304.7	276.9
14	57	369.4	364.5	350.8	327.7	304.8	278.5
12	54	369.6	364.6	350.9	327.8	304.9	278.6
10	50	369.8	364.7	351.0	327.9	304.9	278.7
8	46	369.9	364.8	351.1	327.9	304.9	278.7
6	43	370.0	364.9	349.7	328.0	304.9	272.8
4	40	370.1	365.0	341.5	313.7	286.7	254.9
2	36	370.2	365.1	341.5	313.8	286.8	254.9
0	32	370.3	365.1	341.5	313.8	286.8	255.0
-40	-40	371.0	365.4	341.6	313.8	286.8	255.0

Based on engine bleed for packs on, engine anti-ice off, and wing anti-ice off.**With engine bleed for packs off, increase weight by 1250 kg.****With engine anti-ice on, decrease weight by 150 kg.****With engine and wing anti-ice on, decrease weight by 2350 kg.****When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 24600 kg.**

ENGINE INOP

Go-Around Climb Gradient

Flaps 20, Gear Up

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.

OAT (°C)	REFERENCE GO-AROUND GRADIENT (%)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
54	9.16	7.98	6.54	5.32	4.09	2.49
50	10.10	8.98	7.32	5.99	4.73	3.07
46	11.06	9.95	8.21	6.69	5.39	3.66
42	11.98	10.90	9.09	7.48	6.08	4.27
38	12.83	11.81	9.96	8.25	6.75	4.90
34	13.01	12.64	10.76	8.97	7.32	5.49
30	13.03	12.79	11.43	9.64	7.87	5.98
26	13.06	12.80	11.74	10.19	8.48	6.46
22	13.08	12.81	11.75	10.46	8.89	6.98
18	13.10	12.83	11.75	10.47	9.15	7.33
14	13.13	12.84	11.76	10.47	9.15	7.55
10	13.15	12.85	11.77	10.48	9.16	7.55

Weight Adjustment

WEIGHT (1000 KG)	REFERENCE GO-AROUND GRADIENT (%)											
	2	3	4	5	6	7	8	9	10	11	12	13
320	-4.29	-4.77	-5.26	-5.74	-6.13	-6.59	-7.04	-7.50	-7.95	-8.45	-8.92	-9.39
300	-4.02	-4.44	-4.89	-5.32	-5.66	-6.08	-6.49	-6.90	-7.32	-7.77	-8.21	-8.64
280	-3.56	-3.94	-4.33	-4.72	-5.01	-5.38	-5.74	-6.10	-6.47	-6.89	-7.28	-7.67
260	-3.12	-3.43	-3.77	-4.11	-4.34	-4.66	-4.96	-5.26	-5.58	-5.95	-6.29	-6.63
240	-2.44	-2.67	-2.95	-3.23	-3.39	-3.64	-3.88	-4.11	-4.37	-4.68	-4.96	-5.23
220	-1.61	-1.76	-1.97	-2.17	-2.26	-2.43	-2.58	-2.74	-2.93	-3.15	-3.36	-3.52
200	-0.61	-0.66	-0.76	-0.81	-0.85	-0.91	-0.97	-1.03	-1.12	-1.20	-1.25	-1.28
190	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.66	0.75	0.85	0.88	0.94	1.00	1.07	1.17	1.26	1.30	1.33	1.36
160	2.37	2.67	2.86	3.00	3.20	3.44	3.71	3.95	4.13	4.22	4.33	4.44

Speed Adjustment

SPEED (KIAS)	WEIGHT ADJUSTED GO-AROUND GRADIENT (%)										
	-2	0	2	4	6	8	10	12	14	16	18
VREF	-0.23	-0.24	-0.25	-0.27	-0.28	-0.27	-0.23	-0.16	-0.07	0.03	0.10
VREF+5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VREF+10	0.17	0.18	0.19	0.20	0.21	0.19	0.15	0.07	-0.03	-0.11	-0.14
VREF+20	0.38	0.40	0.42	0.43	0.44	0.37	0.23	-0.01	-0.24	-0.42	-0.56
VREF+30	0.43	0.44	0.44	0.43	0.40	0.28	0.05	-0.28	-0.61	-0.90	-1.12

With engine bleed for packs off, increase gradient by 0.1%.

With engine and wing anti-ice on, decrease gradient by 0.1%.

When operating in icing conditions during any part of the flight with forecast landing temperatures below 10°C, decrease gradient by 1.2%.

Quick Turnaround Limit Weight
Flaps 30 Limit Weight (1000 KG)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	235.5				
50	122	237.0	228.2			
45	113	239.0	230.0	221.4		
40	104	240.9	231.9	223.2	214.8	
35	95	242.9	233.9	225.1	216.6	208.1
30	86	245.0	235.9	227.0	218.4	209.9
25	77	247.1	237.9	228.9	220.3	211.7
20	68	249.2	240.0	231.0	222.2	213.6
15	59	251.5	242.2	233.0	224.1	215.6
10	50	253.8	244.4	235.2	226.2	217.5
5	41	256.2	246.6	237.4	228.3	219.5
0	32	258.6	248.9	239.6	230.4	221.5
-5	23	261.0	251.3	241.9	232.6	223.6
-10	14	262.9	253.8	244.2	234.9	225.8
-15	5	264.8	256.4	246.7	237.3	228.1
-20	-4	266.8	259.0	249.2	239.7	230.4
-30	-22	270.8	263.5	254.4	244.7	235.3
-40	-40	276.0	267.7	260.0	250.1	240.4
-50	-58	282.2	272.0	264.6	255.7	245.8
-54	-65	284.7	274.4	266.4	258.1	248.0

Increase weight by 2100 kg per 1% uphill slope. Decrease weight by 3450 kg per 1% downhill slope.
Increase weight by 6100 kg per 10 knots headwind. Decrease weight by 29450 kg per 10 knots tailwind.
Decrease weight by 12600 kg when one brake is deactivated. Decrease weight by 24950 kg when two brakes are deactivated.

After landing at weights exceeding those shown above, adjusted for slope and wind, wait at least 65 minutes and check that wheel thermal plugs have not melted before executing a takeoff.

As an alternate procedure, no waiting period is required if the BRAKE TEMP advisory message on EICAS is not displayed 10 to 15 minutes after parking.

Intentionally
Blank

Performance Dispatch

Chapter PD

Gear Down

Section 43

GEAR DOWN

Takeoff Climb Limit Weight
Flaps 15

Based on engine bleed for packs on, engine anti-ice off, and wing anti-ice off

AIRPORT OAT		TAKEOFF CLIMB WEIGHT (1000 KG)				
		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	236.9	225.2	209.9	189.5	159.7
52	126	242.3	226.1	214.7	195.1	166.9
50	122	248.1	227.3	217.1	200.5	173.2
48	118	254.1	232.9	217.0	205.8	178.4
46	115	259.9	238.4	218.2	206.1	183.5
44	111	264.7	243.7	223.0	206.0	188.5
42	108	269.1	249.0	227.9	207.1	191.2
40	104	273.8	254.4	233.0	211.6	191.1
38	100	280.0	260.2	238.4	216.4	192.3
36	97	286.2	264.9	243.9	221.5	196.7
34	93	292.5	269.6	249.6	226.7	201.3
32	90	298.3	274.8	255.0	231.8	206.2
30	86	303.7	280.9	260.5	237.2	211.1
28	82	308.6	286.8	265.2	242.4	215.9
26	79	308.7	292.3	269.3	247.6	221.0
24	75	308.8	296.1	273.6	252.7	225.9
22	72	308.9	296.2	278.0	256.7	231.0
20	68	309.0	296.2	280.6	260.0	235.5
18	64	309.1	296.3	280.7	262.7	239.0
16	61	309.2	296.3	280.7	263.7	240.7
14	57	309.3	296.4	280.7	263.7	242.0
12	54	309.4	296.4	280.7	263.7	242.1
10	50	309.5	296.5	280.7	263.7	242.1
-40	-40	309.8	296.5	280.9	263.7	242.0

With engine bleed for packs off, increase weight by 800 kg.

With engine anti-ice on, decrease weight by 900 kg.

With engine and wing anti-ice on, decrease weight by 2250 kg.

GEAR DOWN

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 30

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)				
		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	249.4				
52	126	256.6				
50	122	264.0	241.5			
48	118	272.0	247.4			
46	115	278.7	254.0	234.8		
44	111	285.5	260.6	240.6		
42	108	291.8	268.0	246.3	227.7	
40	104	298.7	274.5	252.1	232.7	
38	100	305.4	280.9	257.9	237.6	211.3
36	97	312.2	286.5	263.0	241.7	215.6
34	93	318.6	292.0	268.8	245.7	219.8
32	90	320.7	297.6	273.8	249.3	223.5
30	86	320.8	302.8	278.7	253.2	226.8
28	82	320.9	307.5	283.1	257.2	230.1
26	79	321.1	307.6	286.4	261.7	233.4
24	75	321.2	307.7	288.9	266.2	237.0
22	72	321.3	307.7	289.9	269.2	240.7
20	68	321.4	307.8	290.0	271.0	243.8
18	64	321.5	307.9	290.0	272.8	246.0
16	61	321.6	308.0	290.1	272.8	247.5
14	57	321.8	308.0	290.1	272.9	248.9
12	54	321.9	308.1	290.1	272.9	249.0
10	50	322.0	308.2	290.2	272.9	249.0
-40	-40	322.5	308.5	290.5	273.1	249.2

With engine bleed for packs off, increase weight 1600 kg.

With engine and wing anti-ice on, decrease weight by 2150 kg.

When operating in icing conditions during any part of the flight when forecast landing temperature is below 10°C, decrease weight by 29150 kg.

GEAR DOWN**Takeoff Obstacle Limit Weight****Flaps 15****Sea Level, 33°C & Below, Zero Wind****Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or Auto**

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	291.3										
20	268.2	287.5									
40	247.9	266.7	281.2	292.1							
60	232.8	251.1	265.7	277.4	286.6	294.1					
80		239.0	253.1	265.0	274.8	282.9	289.5	295.0			
100		227.4	242.3	254.4	264.5	272.9	280.1	286.1	291.2	295.6	298.2
120			232.9	245.0	255.3	264.0	271.5	277.9	283.4	288.1	292.3
140			224.5	236.7	247.0	256.0	263.6	270.3	276.1	281.2	285.6
160			216.9	229.1	239.5	248.6	256.4	263.3	269.3	274.6	279.3
180				222.1	232.6	241.8	249.8	256.8	263.0	268.5	273.3
200				215.7	226.3	235.5	243.6	250.7	257.0	262.7	267.7
220				209.8	220.3	229.6	237.8	245.0	251.4	257.2	262.4
240				204.2	214.8	224.1	232.3	239.6	246.2	252.0	257.3
260				199.1	209.6	218.9	227.2	234.5	241.1	247.1	252.5
280					204.7	214.0	222.3	229.7	236.4	242.4	247.9
300					200.1	209.3	217.7	225.1	231.9	238.0	243.5

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustment

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)						
	180	200	220	240	260	280	300
33 & BELOW	0	0	0	0	0	0	0
34	-1.1	-1.2	-1.4	-1.5	-1.7	-1.8	-2.0
36	-4.1	-4.7	-5.2	-5.8	-6.4	-7.0	-7.5
38	-7.1	-8.1	-9.1	-10.1	-11.1	-12.1	-13.1
40	-10.1	-11.6	-13.0	-14.4	-15.9	-17.3	-18.7
42	-13.7	-15.5	-17.4	-19.2	-21.0	-22.8	-24.6
44	-17.3	-19.5	-21.7	-23.9	-26.2	-28.4	-30.6
46	-20.9	-23.5	-26.1	-28.7	-31.3	-33.9	-36.5
48	-24.5	-27.5	-30.5	-33.5	-36.4	-39.4	-42.4
50	-28.1	-31.4	-34.8	-38.2	-41.6	-45.0	-48.4

GEAR DOWN

Takeoff Obstacle Limit Weight

Flaps 15

Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	180	200	220	240	260	280	300
S.L. & BELOW	0	0	0	0	0	0	0
1000	-7.3	-8.0	-8.7	-9.5	-10.2	-10.9	-11.6
2000	-14.6	-16.0	-17.5	-18.9	-20.4	-21.8	-23.3
3000	-21.0	-23.2	-25.3	-27.5	-29.6	-31.8	-34.0
4000	-27.4	-30.3	-33.2	-36.1	-38.9	-41.8	-44.7
5000	-34.1	-37.7	-41.3	-44.9	-48.5	-52.1	-55.7
6000	-40.7	-45.0	-49.4	-53.7	-58.0	-62.4	-66.7
7000	-47.7	-52.9	-58.1	-63.3	-68.5	-73.7	-78.8
8000	-54.8	-60.8	-66.8	-72.9	-78.9	-85.0	-91.0

Wind Adjustment

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	180	200	220	240	260	280	300
15 TW	-12.7	-15.3	-18.0	-20.7	-23.3	-26.0	-28.7
10 TW	-8.4	-10.2	-12.0	-13.8	-15.6	-17.3	-19.1
5 TW	-4.2	-5.1	-6.0	-6.9	-7.8	-8.7	-9.6
0	0	0	0	0	0	0	0
10 HW	3.9	3.5	3.1	2.6	2.2	1.7	1.3
20 HW	7.9	7.0	6.1	5.2	4.3	3.4	2.6
30 HW	12.1	11.0	9.9	8.7	7.6	6.5	5.4
40 HW	16.4	15.0	13.6	12.3	10.9	9.5	8.2

With engine bleed for packs off, increase weight by 950 kg.

With engine and wing anti-ice on, decrease weight by 3000 kg.

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
360	18500	16600	14200
350	19200	17300	14800
340	19700	18000	15500
330	20600	18900	16300
320	21700	20100	17600
310	22800	21300	19000
300	23900	22400	20300
290	25000	23500	21800
280	26000	24600	23000
270	27100	25900	24300
260	28200	27200	25700
250	29400	28600	27100
240	30400	30000	28500
230	31200	30800	29900
220	32000	31700	31000
210	32800	32600	32000
200	33500	33200	32700
190	34000	33900	33400
180	34600	34500	34100
170	35200	35100	34700
160	35800	35700	35300

GEAR DOWN

**Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
326	291	261	237	217	200	188	177	167	158	150
488	436	391	355	326	300	282	266	251	238	227
649	580	521	473	434	400	376	354	335	318	303
809	724	650	591	543	500	470	443	419	398	380
968	867	779	709	651	600	565	533	504	479	456
1127	1009	908	826	759	700	659	622	589	559	533
1285	1152	1036	944	867	800	754	712	673	639	609
1442	1293	1165	1061	975	900	848	801	758	720	686
1599	1435	1293	1178	1083	1000	943	890	843	800	763
1755	1576	1421	1295	1191	1100	1037	980	928	881	840
1910	1716	1548	1412	1299	1200	1131	1069	1012	962	917
2065	1856	1675	1529	1407	1300	1226	1158	1097	1042	994
2219	1996	1802	1646	1515	1400	1320	1248	1182	1123	1072
2373	2135	1929	1762	1623	1500	1415	1337	1267	1204	1149
2526	2274	2056	1878	1730	1600	1509	1427	1352	1285	1226
2679	2413	2182	1994	1838	1700	1604	1516	1437	1366	1304
2831	2551	2308	2110	1945	1800	1699	1606	1522	1447	1382
2982	2689	2434	2226	2053	1900	1793	1696	1608	1529	1459
3133	2826	2559	2342	2160	2000	1888	1786	1693	1610	1537

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	7.8	0:51	7.4	0:49	7.2	0:47	7.0	0:46	6.9	0:44
300	11.4	1:13	10.8	1:10	10.4	1:07	10.0	1:05	9.7	1:03
400	15.0	1:36	14.2	1:32	13.6	1:28	13.0	1:25	12.6	1:22
500	18.6	1:59	17.6	1:53	16.7	1:48	16.0	1:44	15.4	1:40
600	22.3	2:21	21.1	2:14	20.0	2:08	19.1	2:03	18.4	1:58
700	26.1	2:43	24.6	2:35	23.3	2:28	22.2	2:22	21.3	2:17
800	29.8	3:05	28.1	2:56	26.6	2:48	25.3	2:41	24.2	2:35
900	33.6	3:27	31.6	3:17	29.9	3:08	28.4	3:00	27.2	2:53
1000	37.3	3:49	35.1	3:38	33.2	3:28	31.5	3:20	30.1	3:11
1100	41.3	4:10	38.8	3:59	36.7	3:48	34.7	3:38	33.2	3:29
1200	45.2	4:32	42.4	4:19	40.1	4:07	37.9	3:57	36.2	3:47
1300	49.1	4:53	46.1	4:39	43.5	4:27	41.2	4:15	39.3	4:04
1400	53.0	5:14	49.8	5:00	47.0	4:46	44.4	4:34	42.4	4:22
1500	57.0	5:36	53.4	5:20	50.4	5:05	47.6	4:52	45.5	4:40
1600	61.1	5:56	57.3	5:40	54.0	5:24	51.0	5:11	48.7	4:57
1700	65.2	6:17	61.1	5:59	57.6	5:43	54.4	5:29	51.9	5:15
1800	69.3	6:37	64.9	6:19	61.1	6:02	57.8	5:47	55.2	5:32
1900	73.4	6:58	68.7	6:39	64.7	6:21	61.2	6:05	58.4	5:49
2000	77.5	7:19	72.6	6:58	68.3	6:40	64.6	6:23	61.6	6:07

GEAR DOWN

**Long Range Cruise Trip Fuel and Time
Fuel Required Adjustments (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	160	180	200	220	240
5	-0.4	-0.2	0.0	0.3	0.7
10	-0.9	-0.5	0.0	0.6	1.3
15	-1.3	-0.7	0.0	0.9	2.0
20	-1.8	-1.0	0.0	1.3	2.7
25	-2.3	-1.3	0.0	1.6	3.5
30	-2.8	-1.6	0.0	2.0	4.2
35	-3.3	-1.9	0.0	2.3	5.0
40	-3.9	-2.1	0.0	2.7	5.9
45	-4.4	-2.4	0.0	3.1	6.7
50	-4.9	-2.7	0.0	3.5	7.6
55	-5.4	-2.9	0.0	3.9	8.5
60	-6.0	-3.2	0.0	4.4	9.4
65	-6.5	-3.5	0.0	4.8	10.4
70	-7.0	-3.7	0.0	5.2	11.3
75	-7.6	-4.0	0.0	5.7	12.3
80	-8.1	-4.2	0.0	6.2	13.4

Based on VREF+80 climb, Long Range Cruise and VREF+80 descent.

GEAR DOWN

**Short Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
101	84	72	63	56	50	45	42	38	36	33
171	150	133	120	109	100	92	86	80	75	71
242	215	194	177	162	150	139	130	122	115	109
311	280	255	233	215	200	187	175	165	156	147
380	344	315	290	268	250	234	220	207	196	186
448	408	374	346	321	300	281	265	250	237	225
517	472	434	402	374	350	329	310	293	278	265
586	536	494	458	427	400	376	355	336	319	304
655	600	554	514	480	450	423	400	379	360	343
726	666	615	571	533	500	471	445	421	400	381

Trip Fuel and Time

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		160	180	200	220	240	
50	FUEL (1000 KG)	2.2	2.3	2.5	2.6	2.7	0:15
	ALT (FT)	13000	11000	11000	11000	11000	
100	FUEL (1000 KG)	3.7	3.9	4.1	4.3	4.5	0:25
	ALT (FT)	23000	21000	21000	19000	19000	
150	FUEL (1000 KG)	5.0	5.2	5.5	5.8	6.2	0:34
	ALT (FT)	29000	27000	25000	25000	23000	
200	FUEL (1000 KG)	6.2	6.5	6.9	7.3	7.8	0:43
	ALT (FT)	31000	29000	29000	27000	25000	
250	FUEL (1000 KG)	7.4	7.8	8.3	8.8	9.4	0:51
	ALT (FT)	33000	31000	29000	27000	25000	
300	FUEL (1000 KG)	8.6	9.1	9.6	10.3	11.0	1:00
	ALT (FT)	33000	31000	31000	29000	27000	
350	FUEL (1000 KG)	9.8	10.3	11.0	11.7	12.6	1:08
	ALT (FT)	33000	33000	31000	29000	27000	
400	FUEL (1000 KG)	11.0	11.6	12.3	13.2	14.2	1:16
	ALT (FT)	33000	33000	31000	29000	27000	
450	FUEL (1000 KG)	12.2	12.9	13.7	14.7	15.8	1:25
	ALT (FT)	33000	33000	31000	29000	27000	
500	FUEL (1000 KG)	13.4	14.2	15.1	16.2	17.5	1:33
	ALT (FT)	33000	33000	31000	29000	27000	

GEAR DOWN

**Holding Planning
Flaps Up**

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)						
	PRESSURE ALTITUDE (FT)						
	1500	5000	10000	15000	20000	25000	30000
360	15490						
340	14720	14710					
320	13780	13740					
300	12760	12730	12670				
280	11940	11920	11840				
260	11030	11010	10930	10980			
240	10300	10270	10190	10210			
220	9600	9550	9460	9460	9550		
200	9210	9140	9050	9030	9100	9210	
180	8900	8820	8720	8690	8750	8840	9040
160	8630	8540	8430	8390	8430	8510	8690

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
360	15330	15400	15380	15620	16410
340	14470	14510	14490	14690	15250
320	13540	13550	13540	13670	14090
300	12540	12540	12530	12650	12900
280	11680	11670	11630	11750	11960
260	10760	10730	10680	10790	10930
240	9970	9920	9860	9940	10050
220	9210	9140	9070	9110	9210
200	8700	8610	8520	8540	8620
180	8290	8190	8090	8090	8140
160	7950	7850	7720	7710	7730

These tables include 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
20	171.5	171.5	166.7
18	182.0	180.0	175.8
16	194.2	192.5	188.4
14	207.3	206.6	201.2
12	223.4	221.2	214.5
10	239.5	236.8	229.8
8	256.5	252.7	246.2
6	275.8	268.7	258.8
4	292.6	281.7	268.8
2	306.2	293.1	279.3
0	318.4	303.7	288.9

Anti-Ice Adjustments

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG)										
	PRESSURE ALTITUDE (1000 FT)										
	0	2	4	6	8	10	12	14	16	18	20
ENGINE ONLY	0.0	-0.7	-1.2	-1.2	-1.1	-0.9	-0.7	-0.2	0.0	0.0	0.0
ENGINE AND WING	-2.3	-3.0	-3.0	-3.2	-2.7	-2.4	-1.9	-1.6	-1.3	-1.0	-0.7

Performance Dispatch
Text

Chapter PD
Section 44

Introduction

This chapter contains self dispatch performance data intended primarily for use by flight crews in the event that information cannot be obtained from the airline dispatch office. The data provided is for a single takeoff flap at max takeoff thrust. The range of conditions covered is limited to those normally encountered in airline operation. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

Takeoff

The maximum allowable takeoff weight will be the least of the Field, Climb, Tire Speed, and Obstacle Limit Weights as determined from the following tables. Brake Energy Limit is not shown as it is not limiting for the range of conditions shown in this chapter. When determining a maximum weight for a wet runway, the dry runway limit weight must also be checked and the lower of the two weights used.

Regulations require that the runway length be adjusted to account for alignment of the airplane prior to takeoff. The table below provides TORA, TODA and ASDA adjustments for both 90 degree taxiway entry and 180 degree turnaround. For the 180 degree turnaround case, adjustments are provided for a nominal 60 m runway pavement width. These values may be used when obtaining takeoff weights from the AFM or a takeoff analysis program. When using line-up allowances with the Field Length Limit chart, the field length available must be reduced by the ASDA adjustment.

	90 DEGREE TAXIWAY ENTRY	180 DEGREE TURNAROUND
	MINIMUM LINE-UP DISTANCE (M)	NOMINAL LINE-UP DISTANCE (M) (60.0 M RUNWAY)
TORA & TODA	23	51
ASDA	49	77

Minimum Takeoff Weight

Light weight takeoffs at the GE90-110B1L thrust rating may be limited by minimum takeoff weight in order to maintain airplane controllability during takeoff. For takeoff at weights below the minimum takeoff weight, use of a lower thrust rating and/or the assumed temperature method of thrust reduction is required.

Field Limit Weight - Slope and Wind Corrections

These tables for wet and dry runways provide corrections to the field length available for the effects of runway slope and wind component along the runway. Enter the Slope Correction table with the available field length and runway slope to determine the slope corrected field length. Now enter the Wind Correction table with slope corrected field length and wind component to determine the slope and wind corrected field length.

Field and Climb Limit Weight

Tables are presented for selected airport pressure altitudes and runway condition and show both Field and Climb Limit Weights. Enter the appropriate table for pressure altitude and runway condition with “Slope and Wind Corrected Field Length” determined above and airport OAT to obtain Field Limit Weight. Also read Climb Limit Weight for the same OAT. Intermediate altitudes may be interpolated or use next higher altitude.

When finding a maximum weight for a wet runway, the dry runway limit weight must also be determined and the lower of the two weights used.

Obstacle Limit Weight

This table provides obstacle limit weights for reference airport conditions based on obstacle height above the runway surface and distance from brake release. Enter the correction tables to correct the reference Obstacle Limit Weight for the effects of OAT, pressure altitude and wind as indicated. In the case of multiple obstacles, enter the tables successively with each obstacle and determine the most limiting weight.

When using line-up allowances with the Obstacle Limit chart, the obstacle distance from brake release must be reduced by the ASDA adjustment.

Tire Speed Limit

Maximum tire speed limited weights are presented for 235 MPH tires. To determine the tire speed limit weight, enter the table with OAT, move to airport pressure altitude and read the tire speed limit weight. Adjust the tire speed limit weight according to the notes below the table to account for wind.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table as well as FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations,

unbalanced for brake energy, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. This typically occurs at full rated thrust and light weights and is shown in the Minimum Takeoff Weight tables provided. The options are to select a smaller flaps setting, use reduced takeoff thrust and/or add weight (fuel). Selecting derate thrust is the preferred method of reduced takeoff thrust as this will reduce the minimum control speeds.

Normal takeoff speeds, V1, VR, and V2 are read from either the wet or dry table by entering with takeoff flap setting and brake release weight. Use the tables provided to correct takeoff speeds for altitude and actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind corrections to V1 are obtained by entering the Slope and Wind V1 Adjustment Table.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Minimum V2

Minimum takeoff safety speeds (V2) are provided to ensure an adequate margin between the normal operating speed and the in-air minimum control speed is maintained for directional control with high thrust asymmetry during a light weight takeoff.

Data are presented as a function of airport pressure altitude and are valid for all temperatures. To obtain the proper V2 speed for takeoff, first determine the normal takeoff V2 using the takeoff speeds tables provided, adjusted for pressure altitude, temperature, and VR correction (if applicable). Compare this V2 with the minimum V2. If the calculated V2 is less than the minimum V2, set V2 equal to minimum V2 and determine a new VR by adding the difference between calculated V2 and minimum V2 to the original VR obtained from the V1, VR, V2 Adjustments table or Minimum VR table (if applicable).

Brakes Deactivated

When operating with brakes deactivated, the field limit weight and the V1 must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway limited weight by 4050 kg for a dry runway or 2550 kg for a wet runway and the V1 associated with the reduced weight by 2 knots. With two brakes deactivated, reduce the normal runway limited weight by 8300 kg for a dry runway or 5300 kg for a wet runway and the V1 associated with the reduced weight by 5 knots for a dry runway or 3 knots for a wet runway. If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the dry accelerate stop distance corrected for wind and slope exceeds approximately 1800 m for one brake deactivated or 1900 m for two brakes deactivated. For wet runways, the corrected accelerate stop distance should exceed approximately 2350 m for one brake deactivated or 2450 m for two brakes deactivated.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

One Thrust Reverser Inoperative

Wet runway takeoff performance presented for all brakes operating is based on the use of one thrust reverser during deceleration. When operating with a thrust reverser inoperative, the runway/obstacle limited takeoff weight and V1 speed must be reduced to account for the reduced deceleration capability. A simplified method which conservatively accounts for this is to reduce the normal wet runway/obstacle limited weight by 5050 kg and the V1 associated with the reduced weight by 3 knots.

If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate stop distance available corrected for wind and slope exceeds approximately 2400 m.

Enroute

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination. Data is based on economy climb and descent speeds, and Long Range Cruise with normal engine bleed for air conditioning. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine trip fuel and time for a constant altitude cruise, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time Table with air distance from the Ground to Air Miles Conversion Table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment Table with the Reference Fuel and the planned landing weight to obtain fuel required at the planned landing weight.

Long Range Cruise Step Climb Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination when flying a step climb profile. Step climb profiles are based on 4000 ft step climbs to keep the flight within 2000 ft of the optimum altitude for the current cruise weight. To determine trip fuel and time, enter the Ground to Air Miles Conversion table and determine air distance as discussed above. Then enter the Trip Fuel and Time required with air distance and planned landing weight to read trip fuel. Continue across the table to read trip time.

Short Trip Fuel and Time

These tables are provided to determine trip fuel and time for short distances or alternates. The data considers the use of the FMC short trip optimum altitude. Obtain air distance from upper table using the ground distance and wind component to the alternate. Enter Trip Fuel and Time table with air distance and read trip fuel required for the expected landing weight, together with time to alternate at right. For distances greater than shown or other altitudes, use the Long Range Cruise Trip Fuel and Time tables.

Holding Planning

These tables provide total fuel flow information necessary for planning Flaps Up and Flaps 1 holding and reserve fuel requirements. Data is based on the FMC holding speed schedule which is the higher of the maximum endurance and flaps up maneuver speeds. As noted, the fuel flow is based on flight in a racetrack holding pattern. For holding in straight and level flight, reduce table values by 5%.

Oxygen Requirements

Flight Crew System

Regulations require that sufficient oxygen be provided to the flight crew to account for the greater of supplemental breathing oxygen in the event of a cabin depressurization or protective breathing in the event of smoke or harmful fumes in the flight deck.

For freighter airplanes, regulations also require that sufficient oxygen be provided to the flight crew in case of a main deck cargo fire, which requires cabin depressurization, intermediate level off at 25000 ft altitude, and landing at the nearest suitable airport.

Data are provided to determine the flight crew oxygen dispatch requirements. Table 1 shows the dispatch pressure required for NORMAL regulator setting. Table 2, which can be used if oxygen dispatch requirements are scheduled based on pure oxygen availability, shows the dispatch pressure required for 100% regulator setting.

To determine the flight crew oxygen dispatch requirements, enter the appropriate table with number of crew plus observers using oxygen and total time, which should include maximum diversion time from the intended route to the nearest suitable airport, and read the minimum oxygen system dispatch pressure.

Additional adjustments for more extensive than normal crew usage can be made by adding 0.5 psi/person/minute for NORMAL regulator setting or 2.7 psi/person/minute for 100% regulator setting.

For ambient temperatures above or below 21°C, adjust the required dispatch pressure by the appropriate correction from Table 3.

Net Level Off Weight

The Net Level Off Weight table is provided to determine terrain clearance capability in straight and level flight following an engine failure. Regulations require terrain clearance planning based on net performance which is the gross (or actual) gradient performance degraded by 1.1%. In addition, the net level off pressure altitude must clear the terrain by 1000 ft.

To determine the maximum weight for terrain clearance, enter the table with required net level off pressure altitude and expected ISA deviation to obtain weight. Adjust weight for anti-ice operation as noted below the table.

Extended Range Operations

Regulations require that flights conducted over a route that contains a point further than one hour's time at "normal one engine inoperative speed" from an adequate diversion airport comply with rules set up specifically for "Extended Range Operation with Two Engine airplanes". This section provides reserve fuel planning information for the "Critical Fuel Scenario" based on two engine operation at Long Range Cruise as well as single engine operation at Long Range Cruise.

Long Range Cruise Critical Fuel Reserves

Enter Ground to Air Mile Conversion table with forecast wind and ground distance to diversion airport from critical point to obtain air distance. Now enter Critical Fuel table with air distance and expected weight at the critical point and read required fuel. Apply the noted fuel adjustments as necessary. Regulations require a 5% allowance for performance deterioration unless a value has been established by the operator for in-service deterioration.

As noted below each table, the fuel required is the greater of the two engine fuel and the single engine fuel. This fuel is compared to the amount of fuel normally onboard the airplane at that point in the route. If the fuel required by the critical fuel reserves exceeds the amount of fuel normally expected, the fuel load must be adjusted accordingly.

Landing

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for Flaps 30.

Maximum landing weight is the lowest of the field length limit weight, climb limit weight or maximum certified landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required.

Go-Around Climb Gradient

Enter the Reference Go-around Gradient table with airport OAT and pressure altitude to determine the reference Go-Around Gradient. Then adjust the reference gradient for airplane weight and speed using the tables provided to determine the weight and speed adjusted Go-Around Gradient. Apply the necessary engine bleed corrections as noted. Note that data is for one engine inoperative.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted adjustments as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent takeoff, or ensure the brake temperature is within limits using the alternate procedure described on the page.

Gear Down

This section provides flight planning data for revenue operation with gear down.

Takeoff/Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to determine Takeoff Climb Limit Weight with gear down. Correct the weight obtained for engine bleed configuration as required.

The remaining gear down tables in this section are identical in format and usage to the corresponding gear up tables previously described.

Performance Dispatch**Chapter PD****Table of Contents****Section 50****777-300 PW4090 LB FAA**

Takeoff.....	PD.50.1
Takeoff Field Corrections	PD.50.1
Takeoff Field & Climb Limit Weights	PD.50.2
Takeoff Obstacle Limit Weight.....	PD.50.4
Tire Speed Limit	PD.50.5
Brake Energy Limits VMBE	PD.50.6
Takeoff Speeds	PD.50.7
 Enroute	 PD.51.1
Long Range Cruise Maximum Operating Altitude	PD.51.1
Long Range Cruise Trip Fuel and Time	PD.51.3
Long Range Cruise Step Climb	PD.51.5
Short Trip Fuel and Time	PD.51.6
Holding Planning	PD.51.7
Crew Oxygen Requirements.....	PD.51.7
Net Level Off Weight	PD.51.8
Decompression Critical Fuel Reserves - LRC Cruise	PD.51.9
Driftdown Critical Fuel Reserves - LRC Driftdown/Cruise.....	PD.51.11
 Landing	 PD.52.1
Landing Field Limit Weight	PD.52.1
Landing Climb Limit Weight	PD.52.3
Go-Around Climb Gradient	PD.52.4
Quick Turnaround Limit Weight.....	PD.52.5
 Gear Down.....	 PD.53.1
Takeoff Climb Limit Weight.....	PD.53.1
Landing Climb Limit Weight	PD.53.2
Takeoff Obstacle Limit Weight.....	PD.53.3
Long Range Cruise Altitude Capability	PD.53.4

Long Range Cruise Trip Fuel and Time	PD.53.5
Short Trip Fuel and Time	PD.53.7
Holding Planning	PD.53.8
Net Level Off Weight	PD.53.9
Text.	PD.54.1
Introduction	PD.54.1
Takeoff	PD.54.1
Enroute	PD.54.4
Landing	PD.54.6
Gear Down	PD.54.7

Performance Dispatch

Chapter PD

Takeoff

Section 50

Takeoff Field Corrections
Slope Corrections

FIELD LENGTH AVAILABLE (FT)	SLOPE CORRECTED FIELD LENGTH (FT)								
	RUNWAY SLOPE (%)								
	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
4200	4310	4280	4260	4230	4200	4110	4020	3930	3840
4600	4730	4700	4670	4630	4600	4510	4410	4320	4220
5000	5150	5110	5080	5040	5000	4900	4800	4700	4600
5400	5570	5530	5490	5440	5400	5300	5190	5090	4980
5800	5990	5940	5900	5850	5800	5690	5580	5470	5360
6200	6430	6370	6320	6260	6200	6080	5970	5850	5740
6600	6890	6820	6750	6670	6600	6480	6350	6230	6110
7000	7350	7260	7180	7090	7000	6870	6740	6610	6480
7400	7810	7710	7610	7500	7400	7260	7120	6980	6850
7800	8270	8150	8040	7920	7800	7650	7510	7360	7220
8200	8720	8590	8460	8330	8200	8040	7880	7720	7560
8600	9150	9010	8870	8740	8600	8420	8240	8060	7880
9000	9580	9430	9290	9140	9000	8800	8600	8400	8200
9400	10010	9850	9700	9550	9400	9180	8960	8740	8520
9800	10440	10280	10120	9960	9800	9560	9320	9080	8840
10200	10880	10710	10540	10370	10200	9940	9680	9420	9160
10600	11330	11140	10960	10780	10600	10320	10040	9760	9480
11000	11780	11580	11390	11190	11000	10700	10400	10100	9800
11400	12230	12020	11810	11610	11400	11080	10760	10440	10120
11800	12680	12460	12240	12020	11800	11460	11120	10780	10440

Wind Corrections

SLOPE CORR'D FIELD LENGTH (FT)	SLOPE & WIND CORRECTED FIELD LENGTH (FT)							
	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
4200	2930	3350	3780	4200	4390	4620	4860	5140
4600	3290	3730	4160	4600	4810	5050	5310	5610
5000	3650	4100	4550	5000	5220	5480	5760	6080
5400	4010	4470	4940	5400	5640	5910	6210	6550
5800	4370	4850	5320	5800	6050	6340	6660	7020
6200	4720	5210	5710	6200	6460	6770	7110	7490
6600	5050	5560	6080	6600	6880	7200	7550	7960
7000	5380	5920	6460	7000	7290	7630	8000	8430
7400	5710	6270	6840	7400	7700	8060	8450	8900
7800	6040	6620	7210	7800	8120	8490	8900	9370
8200	6370	6980	7590	8200	8540	8920	9350	9830
8600	6700	7330	7970	8600	8960	9360	9800	10280
9000	7030	7680	8340	9000	9380	9800	10250	10730
9400	7360	8040	8720	9400	9810	10240	10700	11180
9800	7690	8390	9100	9800	10230	10680	11140	11630
10200	8020	8740	9470	10200	10650	11120	11590	12090
10600	8350	9100	9850	10600	11060	11550	12040	12560
11000	8680	9450	10230	11000	11480	11980	12490	13030
11400	9010	9800	10600	11400	11890	12410	12940	13500
11800	9340	10160	10980	11800	12310	12840	13390	13970

Takeoff Field & Climb Limit Weights**Flaps 15****Sea Level Pressure Altitude**

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)											
	OAT											
	°C	-40	15	20	22	24	28	30	32	36	44	50
	°F	-40	59	68	72	75	82	86	90	97	111	122
4000	413.1	373.1	370.0	368.8	367.6	365.2	364.0	360.5	352.5	331.7	314.4	
4200	425.0	384.0	380.8	379.5	378.3	375.8	374.6	371.0	362.8	341.6	323.9	
4600	447.6	404.8	401.5	400.2	398.9	396.4	395.1	391.3	382.8	360.6	342.2	
5000	468.8	424.4	421.0	419.6	418.3	415.6	414.3	410.4	401.5	378.5	359.4	
5400	488.1	442.3	438.7	437.3	436.0	433.2	431.9	427.8	418.7	395.0	375.2	
5800	506.5	459.4	455.8	454.3	452.9	450.1	448.7	444.6	435.1	410.8	390.5	
6200	523.9	475.7	471.9	470.5	469.0	466.1	464.7	460.4	450.8	425.8	405.0	
6600	540.6	491.2	487.4	485.9	484.4	481.4	480.0	475.7	465.8	440.2	418.9	
7000	556.8	506.3	502.4	500.9	499.3	496.3	494.8	490.4	480.3	454.2	432.4	
7400	572.4	520.8	516.8	515.3	513.7	510.6	509.1	504.6	494.3	467.6	445.3	
7800	587.6	535.0	530.9	529.3	527.7	524.5	523.0	518.3	507.8	480.6	457.9	
8200	602.7	549.0	544.8	543.2	541.6	538.4	536.8	532.1	521.3	493.5	470.3	
8600	617.2	562.5	558.2	556.6	554.9	551.6	550.0	545.2	534.2	505.9	482.3	
9000	630.6	574.8	570.5	568.8	567.1	563.8	562.1	557.2	546.1	517.2	493.1	
9400	643.0	586.3	581.8	580.1	578.4	575.0	573.3	568.3	557.0	527.6	503.1	
9800	655.1	597.4	592.9	591.1	589.4	585.9	584.2	579.2	567.6	537.7	512.8	
10200	666.7	608.1	603.6	601.8	600.0	596.5	594.8	589.6	577.9	547.5	522.3	
10600	677.9	618.5	613.9	612.1	610.3	606.8	605.0	599.8	587.9	557.1	531.5	
CLIMB LIMIT WT (1000 LB)	660.6	658.8	658.6	658.5	658.4	658.2	658.1	649.8	630.7	578.2	532.5	

1000 FT Pressure Altitude

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)											
	OAT											
	°C	-40	15	20	22	24	28	30	32	36	44	50
	°F	-40	59	68	72	75	82	86	90	97	111	122
4000	400.0	361.1	358.1	356.9	355.8	353.4	350.3	347.0	339.0	319.3	302.6	
4200	411.5	371.7	368.6	367.4	366.2	363.8	360.6	357.2	349.0	328.9	311.8	
4600	433.6	392.1	388.8	387.6	386.3	383.8	380.5	376.9	368.4	347.4	329.5	
5000	454.3	411.2	407.8	406.5	405.2	402.6	399.1	395.5	386.6	364.8	346.3	
5400	473.1	428.6	425.2	423.8	422.5	419.8	416.2	412.4	403.3	380.8	361.7	
5800	491.0	445.4	441.8	440.4	439.0	436.3	432.6	428.7	419.3	396.2	376.6	
6200	508.1	461.3	457.6	456.2	454.8	452.0	448.2	444.2	434.5	410.8	390.7	
6600	524.4	476.5	472.8	471.3	469.8	467.0	463.1	459.0	449.1	424.9	404.4	
7000	540.2	491.2	487.4	485.9	484.4	481.5	477.6	473.4	463.3	438.5	417.5	
7400	555.5	505.4	501.5	500.0	498.5	495.5	491.5	487.2	476.9	451.6	430.1	
7800	570.3	519.2	515.3	513.7	512.1	509.1	505.0	500.6	490.1	464.2	442.3	
8200	585.1	533.0	528.9	527.3	525.7	522.6	518.4	514.0	503.2	476.9	454.5	
8600	599.3	546.1	542.0	540.4	538.7	535.6	531.3	526.8	515.8	488.9	466.1	
9000	612.3	558.2	553.9	552.3	550.6	547.4	543.1	538.5	527.3	499.9	476.7	
9400	624.4	569.3	565.0	563.3	561.6	558.3	553.9	549.2	537.8	510.0	486.3	
9800	636.2	580.1	575.8	574.1	572.3	569.0	564.5	559.7	548.1	519.8	495.7	
10200	647.5	590.6	586.2	584.5	582.7	579.3	574.8	569.9	558.1	529.4	504.9	
10600	658.5	600.8	596.3	594.5	592.8	589.3	584.7	579.8	567.9	538.7	514.0	
CLIMB LIMIT WT (1000 LB)	643.3	641.6	641.4	641.3	641.2	640.7	633.8	626.2	607.0	557.1	512.9	

With engine bleed for packs off, increase field limit weight by 1400 lb and climb limit weight by 4400 lb.

With engine anti-ice on, decrease field limit weight by 200 lb and climb limit weight by 1100 lb.

With engine and wing anti-ice on, decrease field limit weight by 2300 lb and climb limit weight by 4600 lb.

Takeoff Field & Climb Limit Weights

Flaps 15

2000 FT Pressure Altitude

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)											
	OAT											
	°C	-40	15	20	22	24	28	30	32	36	44	50
	°F	-40	59	68	72	75	82	86	90	97	111	122
4000	386.9	349.2	346.2	345.1	343.9	339.6	337.0	333.9	326.2	307.1	290.2	
4200	398.1	359.5	356.5	355.3	354.1	349.7	347.0	343.8	336.0	316.4	299.1	
4600	419.6	379.3	376.1	374.9	373.7	369.0	366.3	363.0	354.8	334.3	316.3	
5000	439.7	397.9	394.6	393.4	392.1	387.3	384.4	381.0	372.4	351.2	332.5	
5400	458.0	414.9	411.6	410.3	409.0	404.0	401.0	397.5	388.7	366.8	347.6	
5800	475.6	431.3	427.8	426.5	425.1	420.0	417.0	413.3	404.3	381.8	362.0	
6200	492.3	446.8	443.3	441.9	440.5	435.3	432.2	428.4	419.2	396.1	375.8	
6600	508.2	461.7	458.1	456.7	455.3	449.9	446.7	442.9	433.4	409.9	389.1	
7000	523.7	476.2	472.5	471.0	469.6	464.1	460.8	456.9	447.2	423.1	401.9	
7400	538.6	490.0	486.3	484.8	483.3	477.7	474.4	470.4	460.5	435.8	414.1	
7800	553.1	503.5	499.6	498.1	496.6	490.9	487.5	483.4	473.3	448.2	426.0	
8200	567.5	516.9	513.0	511.4	509.9	504.1	500.6	496.4	486.1	460.5	437.9	
8600	581.3	529.8	525.7	524.2	522.6	516.6	513.1	508.9	498.4	472.2	449.2	
9000	594.0	541.5	537.4	535.8	534.2	528.1	524.5	520.2	509.5	482.9	459.4	
9400	605.8	552.3	548.2	546.5	544.9	538.7	535.1	530.7	519.8	492.6	468.7	
9800	617.2	562.9	558.6	557.0	555.3	549.0	545.3	540.8	529.8	502.2	477.8	
10200	628.3	573.1	568.8	567.1	565.4	559.0	555.3	550.7	539.5	511.5	486.8	
10600	639.0	583.0	578.7	577.0	575.3	568.8	565.0	560.4	549.0	520.6	495.6	
CLIMB LIMIT WT (1000 LB)	624.8	623.2	623.0	622.8	622.6	615.2	610.0	603.1	584.3	535.2	491.8	

3000 FT Pressure Altitude

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)											
	OAT											
	°C	-40	15	20	22	24	28	30	32	36	44	50
	°F	-40	59	68	72	75	82	86	90	97	111	122
4000	373.8	337.2	334.3	332.6	330.7	326.4	323.8	320.8	313.7	295.2	278.4	
4200	384.6	347.2	344.3	342.5	340.5	336.1	333.5	330.4	323.1	304.2	287.1	
4600	405.5	366.5	363.4	361.6	359.5	354.9	352.2	349.0	341.3	321.6	303.7	
5000	425.1	384.6	381.4	379.5	377.4	372.6	369.8	366.4	358.5	338.0	319.5	
5400	443.0	401.2	398.0	396.0	393.8	388.9	386.0	382.5	374.4	353.2	334.1	
5800	460.2	417.2	413.9	411.8	409.6	404.5	401.5	398.0	389.6	367.8	348.1	
6200	476.4	432.4	429.0	426.9	424.6	419.4	416.3	412.7	404.1	381.8	361.6	
6600	492.0	447.0	443.5	441.3	438.9	433.6	430.5	426.8	418.0	395.2	374.5	
7000	507.1	461.0	457.5	455.3	452.9	447.4	444.2	440.4	431.4	408.1	387.0	
7400	521.7	474.6	470.9	468.7	466.2	460.7	457.4	453.5	444.3	420.5	399.0	
7800	535.8	487.7	484.0	481.7	479.2	473.5	470.2	466.2	456.8	432.5	410.5	
8200	549.9	500.8	497.0	494.7	492.1	486.4	483.0	478.9	469.3	444.5	422.1	
8600	563.4	513.4	509.5	507.1	504.5	498.6	495.1	491.0	481.2	455.9	433.0	
9000	575.7	524.8	520.8	518.4	515.7	509.7	506.2	502.0	492.0	466.3	443.0	
9400	587.2	535.3	531.3	528.8	526.1	520.0	516.4	512.1	502.0	475.7	452.0	
9800	598.3	545.6	541.5	538.9	536.2	530.0	526.3	522.0	511.7	485.0	460.8	
10200	609.1	555.5	551.4	548.8	546.0	539.7	536.0	531.6	521.1	494.0	469.5	
10600	619.5	565.3	561.0	558.4	555.6	549.2	545.5	541.0	530.4	502.9	478.1	
CLIMB LIMIT WT (1000 LB)	606.5	605.0	604.5	602.2	599.5	592.3	586.9	579.8	562.5	514.5	474.8	

With engine bleed for packs off, increase field limit weight by 1400 lb and climb limit weight by 4400 lb.

With engine anti-ice on, decrease field limit weight by 200 lb and climb limit weight by 1100 lb.

With engine and wing anti-ice on, decrease field limit weight by 2300 lb and climb limit weight by 4600 lb.

Copyright © The Boeing Company. See title page for details.

Takeoff Obstacle Limit Weight**Flaps 15****Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off****Sea Level, 30°C & Below, Zero Wind**

OBSTACLE HEIGHT (FT)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 LB)								
	DISTANCE FROM BRAKE RELEASE (1000 FT)								
	8	10	12	14	16	18	20	22	24
10	522.3	580.8	628.0	664.2	685.1	703.4			
50	493.7	547.0	590.7	625.5	653.7	671.4	685.7	698.3	708.8
100	465.5	515.2	556.5	590.3	618.3	642.2	660.8	673.2	683.8
150	440.7	489.7	529.4	563.8	592.9	616.6	636.2	652.5	664.6
200	419.6	468.4	507.8	542.5	571.4	595.4	615.2	632.0	646.2
250	401.2	448.9	489.9	523.9	552.6	576.8	597.0	614.1	628.8
300	384.8	433.0	474.1	507.3	535.8	560.0	580.7	598.1	613.1
350	370.0	418.7	459.4	492.4	520.6	544.9	565.7	583.6	598.9
400	357.5	405.6	445.7	478.9	506.8	531.0	551.9	570.0	585.8
450	346.2	393.5	433.0	466.4	494.0	518.1	539.1	557.4	573.5
500		382.3	421.3	454.4	482.3	506.2	527.2	545.7	561.9
550		371.9	410.4	443.2	471.3	495.0	516.0	534.6	551.0
600		362.2	400.2	432.7	460.7	484.6	505.5	524.1	540.6
650		353.0	390.6	422.8	450.7	474.8	495.6	514.3	530.9
700		344.4	381.5	413.5	441.2	465.5	486.3	504.9	521.5
750		346.6	373.0	404.6	432.2	456.4	477.4	495.9	512.7
800			364.8	396.2	423.6	447.7	469.0	487.5	504.2
850			357.1	388.2	415.5	439.5	460.7	479.4	496.1
900			349.7	380.6	407.7	431.6	452.8	471.7	488.3
950			342.7	373.4	400.3	424.0	445.2	464.2	480.9
1000				366.4	393.1	416.8	437.9	456.9	473.8

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.**OAT Adjustments**

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 LB)						
	400	450	500	550	600	650	700
30 & Below	0	0	0	0	0	0	0
32	-6.0	-6.8	-7.5	-8.3	-9.1	-9.9	-10.6
34	-12.0	-13.5	-15.1	-16.6	-18.2	-19.7	-21.3
36	-18.0	-20.3	-22.6	-25.0	-27.3	-29.6	-31.9
38	-24.0	-27.1	-30.2	-33.3	-36.4	-39.5	-42.6
40	-30.0	-33.9	-37.7	-41.6	-45.5	-49.3	-53.2
42	-37.4	-42.5	-47.7	-52.8	-57.9	-63.0	-68.2
44	-44.8	-51.2	-57.6	-64.0	-70.3	-76.7	-83.1
46	-52.2	-59.8	-67.5	-75.1	-82.8	-90.4	-98.1
48	-59.6	-68.5	-77.4	-86.3	-95.2	-104.1	-113.0
50	-67.0	-77.2	-87.3	-97.5	-107.7	-117.8	-128.0

Pressure Altitude Adjustments

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 LB)						
	400	450	500	550	600	650	700
S.L. & Below	0	0	0	0	0	0	0
1000	-14.9	-16.7	-18.5	-20.2	-22.0	-23.8	-25.6
2000	-29.7	-33.1	-36.5	-39.9	-43.3	-46.7	-50.1
3000	-43.6	-48.8	-54.0	-59.1	-64.3	-69.5	-74.6

Takeoff Obstacle Limit Weight

Flaps 15

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

Wind Adjustments

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 LB)						
	400	450	500	550	600	650	700
15 TW	-57.6	-57.6	-57.6	-57.6	-57.6	-57.6	-57.5
10 TW	-38.4	-38.4	-38.4	-38.4	-38.4	-38.4	-38.4
5 TW	-19.2	-19.2	-19.2	-19.2	-19.2	-19.2	-19.2
0	0	0	0	0	0	0	0
10 HW	8.2	7.7	7.1	6.5	6.0	5.4	4.8
20 HW	16.5	15.3	14.2	13.1	11.9	10.8	9.6
30 HW	25.8	23.8	21.9	20.0	18.1	16.1	14.2
40 HW	35.1	32.4	29.6	26.9	24.2	21.5	18.7

With engine bleed for packs off, increase weight by 1700 lb.

With engine anti-ice on, decrease weight by 1000 lb.

With engine and wing anti-ice on, decrease weight by 3200 lb.

Tire Speed Limit

Flaps 15

AIRPORT		TIRE SPEED LIMIT WEIGHT (1000 LB)					
		AIRPORT PRESSURE ALTITUDE (FT)					
(°C)	(°F)	-2000	0	2000	4000	6000	8000
54	129	715.0	701.8	651.8	602.8	556.8	514.0
52	126	715.0	705.6	655.7	606.3	560.1	517.0
50	122	715.0	709.4	659.5	609.8	563.3	519.9
48	118	715.0	711.6	663.2	613.5	566.7	523.0
46	115	715.0	713.8	666.9	617.1	570.1	526.1
44	111	715.0	715.0	670.7	620.8	573.6	529.3
42	108	715.0	715.0	674.5	624.5	577.0	532.6
40	104	715.0	715.0	678.2	628.2	580.5	535.9
38	100	715.0	715.0	682.3	632.1	584.1	539.2
36	97	715.0	715.0	686.3	636.0	587.7	542.5
34	93	715.0	715.0	690.4	640.0	591.3	545.9
32	90	715.0	715.0	694.7	644.2	595.2	549.6
30	86	715.0	715.0	699.1	648.6	599.3	553.4
28	82	715.0	715.0	703.7	653.1	603.4	557.3
26	79	715.0	715.0	708.4	657.7	607.7	561.2
24	75	715.0	715.0	713.1	662.5	612.1	565.1
22	72	715.0	715.0	715.0	667.0	616.5	569.2
20	68	715.0	715.0	715.0	671.6	621.0	573.4
18	64	715.0	715.0	715.0	676.3	625.6	577.6
16	61	715.0	715.0	715.0	681.1	630.2	581.8
14	57	715.0	715.0	715.0	686.0	634.9	586.2
12	54	715.0	715.0	715.0	691.0	639.7	590.6
10	50	715.0	715.0	715.0	696.0	644.7	595.0
-40	-40	715.0	715.0	715.0	715.0	715.0	715.0

Increase tire speed limit weight by 5200 lb per knot headwind.

Decrease tire speed limit weight by 6600 lb per knot tailwind.

Brake Energy Limits VMBE
Maximum Brake Energy Speed

OAT (°C)	REFERENCE VMBE (KIAS)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
54	195	188				
50	196	189	182			
46	196	189	182	176		
42	196	189	183	176	170	
38	197	190	183	176	170	164
34	199	190	184	177	171	165
30	200	191	184	178	172	165
26	202	193	185	179	173	167
22	204	194	187	180	174	168
18	206	196	189	182	175	169
14	208	198	190	183	176	170
10	210	200	192	185	178	171
6	210	202	194	186	179	173
2	210	204	196	188	181	174
-2	210	206	198	190	183	176
-6	210	208	200	192	185	178
-10	210	210	202	194	186	179

Weight Adjusted VMBE

WEIGHT (1000 LB)	REFERENCE VMBE (KIAS)										
	160	165	170	175	180	185	190	195	200	205	210
420	185	191	197	204	210	210	210	210	210	210	210
440	180	186	192	198	204	210	210	210	210	210	210
460	175	181	187	192	198	204	210	210	210	210	210
480	171	176	182	187	193	199	204	210	210	210	210
500	167	172	178	183	188	194	199	204	210	210	210
520	163	168	174	179	184	189	194	200	205	210	210
540	160	165	170	175	180	185	190	195	200	205	210
560	157	162	167	171	176	181	186	191	196	200	205
580	154	159	163	168	173	177	182	187	191	196	201
600	151	156	160	165	169	174	178	183	187	192	197
620	149	153	157	162	166	171	175	179	184	188	193
640	146	151	155	159	164	168	172	176	181	185	189
660	144	148	153	157	161	165	169	173	177	182	186

Increase VMBE by 3 knots per 1% uphill runway slope. Decrease VMBE by 6 knots per 1% downhill runway slope.

Increase VMBE by 5 knot per 10 knots headwind. Decrease VMBE by 23 knots per 10 knots tailwind.

Decrease VMBE by 11 knots for one brake deactivated and 22 knots for two brakes deactivated.

Decrease brake release weight by 5200 lb for each knot V1 exceeds VMBE.

Determine normal V1, VR, V2 speeds for lower brake release weight.

Takeoff Speeds

Flaps 15

V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 LB)	KIAS		
	V1	VR	V2
680	170	179	184
660	167	176	181
640	164	173	179
620	161	170	176
600	158	167	174
580	154	164	171
560	151	161	169
540	147	157	166
520	144	154	163
500	140	151	160
480	136	147	158
460	132	143	155
440	127	140	151
420	122	136	148
400	117	132	145
380	113	128	142
360	108	124	138
340	102	119	134

Check V1(MCG) and minimum VR.

V1, VR, V2 Adjustments*

TEMP		V1					VR					V2				
		PRESS ALT (FT)					PRESS ALT (FT)					PRESS ALT (FT)				
°C	°F	-2000	0	1000	2000	3000	-2000	0	1000	2000	3000	-2000	0	1000	2000	3000
50	122	5	8	9	11	12	2	3	4	4	5	-1	-2	-2	-2	-2
40	104	0	4	5	6	8	0	2	2	3	3	0	-1	-1	-1	-1
30	86	0	0	2	3	5	0	0	1	2	2	0	0	0	-1	-1
20	68	0	0	1	2	3	0	0	1	1	1	0	0	0	0	-1
-40	-40	0	0	1	2	3	0	0	1	1	1	0	0	0	0	-1

Slope and Wind V1 Adjustments*

WEIGHT (1000 LB)	SLOPE (%)					WIND (KTS)								
	-2	-1	0	1	2	-15	-10	-5	0	10	20	30	40	
680	-5	-2	0	3	5	-3	-1	-1	0	0	1	1	2	
660	-5	-2	0	3	5	-3	-1	-1	0	0	1	1	2	
620	-4	-2	0	3	5	-2	-1	0	0	1	2	2	2	
580	-3	-1	0	3	5	-1	0	0	0	1	2	2	2	
540	-3	-1	0	3	4	-1	0	0	0	1	2	2	3	
500	-2	0	0	3	4	-1	0	0	0	1	2	2	3	
460	-2	0	0	3	4	-1	0	0	0	1	2	2	3	
420	-2	0	0	3	4	-1	0	0	0	1	2	2	3	
380	-2	0	0	3	4	-1	0	0	0	1	2	2	3	
340	-2	0	0	3	4	-1	0	0	0	1	2	2	3	

*V1 not to exceed VR

Takeoff Speeds
Flaps 15
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)									
		-2000		0		1000		2000		3000	
°C	°F	V1(MCG)	Min VR	V1(MCG)	Min VR	V1(MCG)	Min VR	V1(MCG)	Min VR	V1(MCG)	Min VR
50	122	104	109	100	105	98	104	96	102	95	101
40	104	110	114	106	111	104	109	102	107	100	105
30	86	110	115	110	115	108	113	106	111	103	109
20	68	110	115	110	115	108	113	107	112	105	110
-40	-40	111	115	111	115	109	113	107	112	106	110

Performance Dispatch

Enroute

Chapter PD

Section 51

Long Range Cruise Maximum Operating Altitude

Max Climb Thrust

ISA + 10°C and Below

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
660	29500	0	32800*	32800*	32800*	32800*	32200
640	30100	-1	33600*	33600*	33600*	33600*	32900
620	30800	-3	34300*	34300*	34300*	34300*	33500
600	31500	-4	35100*	35100*	35100*	35100*	34200
580	32300	-6	35800*	35800*	35800*	35800*	35000
560	33000	-8	36300*	36300*	36300*	36300*	35700
540	33800	-9	37000*	37000*	37000*	37000*	36400
520	34600	-11	37800*	37800*	37800*	37800*	37200
500	35400	-13	38600*	38600*	38600*	38600*	38000
480	36300	-14	39400*	39400*	39400*	39400*	38900
460	37200	-14	40200*	40200*	40200*	40200*	39800
440	38100	-14	41100*	41100*	41100*	41100*	40700
420	39100	-14	42000*	42000*	42000*	42000*	41700
400	40100	-14	43000*	43000*	43000*	43000*	42700
380	41100	-14	43100	43100	43100	43100	43100
360	42300	-14	43100	43100	43100	43100	43100
340	43100	-14	43100	43100	43100	43100	43100

ISA + 15°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
660	29500	6	31800*	31800*	31800*	31800*	31800*
640	30100	5	32600*	32600*	32600*	32600*	32600*
620	30800	3	33400*	33400*	33400*	33400*	33400*
600	31500	1	34300*	34300*	34300*	34300*	34200
580	32300	0	35100*	35100*	35100*	35100*	35000
560	33000	-2	35800*	35800*	35800*	35800*	35700
540	33800	-4	36400*	36400*	36400*	36400*	36400
520	34600	-5	37200*	37200*	37200*	37200*	37200
500	35400	-7	38000*	38000*	38000*	38000*	38000
480	36300	-9	38800*	38800*	38800*	38800*	38800*
460	37200	-9	39600*	39600*	39600*	39600*	39600*
440	38100	-9	40500*	40500*	40500*	40500*	40500*
420	39100	-9	41400*	41400*	41400*	41400*	41400*
400	40100	-9	42300*	42300*	42300*	42300*	42300*
380	41100	-9	43100	43100	43100	43100	43100
360	42300	-9	43100	43100	43100	43100	43100
340	43100	-9	43100	43100	43100	43100	43100

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
660	29500	12	30300*	30300*	30300*	30300*	30300*
640	30100	10	31200*	31200*	31200*	31200*	31200*
620	30800	9	32100*	32100*	32100*	32100*	32100*
600	31500	7	33000*	33000*	33000*	33000*	33000*
580	32300	6	34000*	34000*	34000*	34000*	34000*
560	33000	4	34900*	34900*	34900*	34900*	34900*
540	33800	2	35600*	35600*	35600*	35600*	35600*
520	34600	0	36200*	36200*	36200*	36200*	36200*
500	35400	-2	37000*	37000*	37000*	37000*	37000*
480	36300	-3	37800*	37800*	37800*	37800*	37800*
460	37200	-3	38700*	38700*	38700*	38700*	38700*
440	38100	-3	39500*	39500*	39500*	39500*	39500*
420	39100	-3	40400*	40400*	40400*	40400*	40400*
400	40100	-3	41300*	41300*	41300*	41300*	41300*
380	41100	-3	42300*	42300*	42300*	42300*	42300*
360	42300	-3	43100	43100	43100	43100	43100
340	43100	-3	43100	43100	43100	43100	43100

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
527	496	468	443	420	400	382	366	351	337	324
1041	982	929	882	839	800	766	735	706	679	655
1553	1468	1390	1320	1258	1200	1150	1104	1061	1022	987
2063	1952	1850	1758	1676	1600	1534	1473	1417	1365	1318
2572	2435	2309	2196	2094	2000	1919	1843	1773	1708	1649
3079	2916	2767	2633	2512	2400	2303	2213	2129	2051	1980
3584	3397	3224	3070	2929	2800	2687	2582	2485	2395	2312
4089	3877	3681	3506	3347	3200	3072	2952	2841	2738	2644
4594	4356	4138	3942	3764	3600	3456	3322	3197	3082	2976
5097	4835	4594	4378	4182	4000	3840	3692	3553	3425	3308
5599	5313	5050	4814	4599	4400	4225	4061	3909	3769	3640
6101	5791	5506	5249	5016	4800	4609	4431	4265	4112	3972
6603	6269	5961	5685	5433	5200	4994	4801	4622	4456	4304
7105	6746	6417	6120	5850	5600	5378	5170	4978	4800	4636
7607	7224	6873	6556	6267	6000	5762	5540	5334	5143	4968
8109	7703	7329	6991	6684	6400	6147	5910	5690	5486	5299
8612	8181	7785	7427	7101	6800	6531	6280	6046	5830	5631
9114	8659	8241	7863	7519	7200	6915	6649	6402	6173	5963
9617	9138	8696	8298	7936	7600	7300	7019	6758	6517	6295
10119	9616	9152	8734	8353	8000	7684	7389	7114	6860	6627

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)							
	29		31		33		35 & ABOVE	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
400	16.1	1:02	16.1	1:02	15.9	1:02	15.9	1:02
800	29.3	1:56	28.8	1:56	28.4	1:56	28.1	1:56
1200	42.6	2:48	41.8	2:48	41.0	2:48	40.5	2:48
1600	56.2	3:40	55.0	3:40	53.9	3:40	53.2	3:40
2000	69.8	4:31	68.2	4:31	66.8	4:31	65.9	4:31
2400	83.9	5:22	81.9	5:22	80.3	5:22	79.4	5:22
2800	98.1	6:12	95.7	6:12	93.8	6:12	92.8	6:12
3200	112.5	7:02	109.8	7:02	107.7	7:02	106.8	7:02
3600	127.3	7:52	124.3	7:52	122.0	7:52	121.2	7:52
4000	142.0	8:41	138.7	8:41	136.3	8:41	135.7	8:41
4400	157.5	9:30	153.9	9:30	151.5	9:30	151.6	9:30
4800	172.9	10:19	169.1	10:19	166.7	10:19	167.5	10:19
5200	188.7	11:08	184.8	11:08	182.6	11:08		
5600	204.9	11:57	200.9	11:57	199.1	11:57		
6000	221.1	12:45	217.0	12:45	215.6	12:45		
6400	238.1	13:34	234.2	13:34				
6800	255.0	14:23	251.4	14:23				
7200	272.6	15:11						
7600	290.9	16:00						
8000	309.1	16:49						

Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	LANDING WEIGHT (1000 LB)				
	350	400	450	500	550
20	-2.5	-1.3	0.0	1.5	3.1
40	-4.9	-2.5	0.0	3.0	6.5
60	-7.3	-3.6	0.0	4.7	10.3
80	-9.8	-4.9	0.0	6.5	14.7
100	-12.3	-6.1	0.0	8.6	19.4
120	-14.9	-7.5	0.0	10.8	24.7
140	-17.5	-8.8	0.0	13.2	30.4
160	-20.2	-10.2	0.0	15.7	36.5
180	-23.0	-11.7	0.0	18.4	43.1
200	-25.8	-13.2	0.0	21.3	50.2
220	-28.6	-14.7	0.0	24.4	57.7
240	-31.6	-16.3	0.0	27.6	65.7
260	-34.5	-17.9	0.0	31.0	74.2
280	-37.5	-19.6	0.0	34.5	83.1
300	-40.6	-21.4	0.0	38.3	92.5
320	-43.8	-23.1	0.0	42.2	102.3
340	-46.9	-25.0	0.0	46.3	112.6

Based on 310/.84 climb, Long Range Cruise and .84/310/250 descent.

Long Range Cruise Step Climb
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1293	1221	1157	1100	1047	1000	957	917	880	847	815
1923	1820	1728	1645	1569	1500	1437	1379	1325	1276	1230
2553	2419	2299	2190	2091	2000	1917	1841	1770	1705	1644
3183	3018	2869	2735	2612	2500	2397	2302	2215	2134	2058
3812	3617	3440	3280	3134	3000	2877	2764	2660	2563	2473
4442	4215	4010	3824	3655	3500	3358	3226	3105	2992	2888
5072	4814	4581	4369	4177	4000	3838	3688	3550	3422	3302
5701	5412	5151	4914	4698	4500	4318	4150	3995	3851	3717
6331	6011	5722	5459	5219	5000	4798	4612	4440	4280	4131
6961	6610	6292	6004	5741	5500	5278	5074	4885	4709	4546
7591	7208	6863	6549	6262	6000	5759	5536	5330	5139	4961
8221	7807	7433	7094	6784	6500	6239	5998	5775	5568	5375
8851	8406	8004	7639	7306	7000	6719	6460	6220	5997	5789
9481	9005	8575	8184	7827	7500	7199	6921	6664	6426	6204
10112	9605	9146	8729	8349	8000	7679	7383	7109	6855	6618

Trip Fuel and Time Required

AIR DIST (NM)	TRIP FUEL (1000 LB)					TIME (HRS:MIN)
	LANDING WEIGHT (1000 LB)					
	350	400	450	500	550	
1000	28.6	31.9	34.6	37.7	40.8	2:16
1500	41.2	46.0	50.4	55.0	59.6	3:18
2000	54.2	60.6	66.6	72.7	79.0	4:20
2500	67.6	75.5	83.3	91.0	98.9	5:22
3000	81.4	90.9	100.4	109.8	119.4	6:24
3500	95.5	106.9	118.0	129.2	140.4	7:25
4000	110.1	123.3	136.1	149.2	162.0	8:27
4500	125.0	140.1	154.8	169.6	184.3	9:29
5000	140.4	157.5	174.0	190.6	207.4	10:31
5500	156.3	175.3	193.8	212.2	231.2	11:32
6000	172.7	193.6	214.2	234.6	256.0	12:34
6500	189.6	212.5	235.0	257.6	282.3	13:36
7000	206.9	232.0	256.5	281.5	308.5	14:38
7500	224.7	252.0	278.7	306.2	337.5	15:40
8000	243.0	272.6	301.5	331.9	366.4	16:43

Based on 310/.84 climb, LRC and .84/310/250 descent.
Valid for all pressure altitudes with 4000 ft step climb to 2000 ft above optimum altitude.

Short Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
94	80	69	61	55	50	46	42	39	36	34
159	142	129	118	108	100	93	87	82	77	73
224	204	187	173	161	150	141	132	125	119	113
287	264	245	228	213	200	189	178	169	161	153
349	324	301	282	265	250	237	224	214	204	195
411	382	358	336	317	300	285	271	258	247	236
472	441	414	390	369	350	333	317	303	290	278
534	500	471	445	421	400	381	364	348	333	320
597	560	528	499	473	450	429	410	392	376	361
661	621	586	554	526	500	477	456	436	418	402

Trip Fuel and Time Required

AIR DIST (NM)		LANDING WEIGHT (1000 LB)					TIME (HRS:MIN)
		350	400	450	500	550	
50	FUEL (1000 LB)	3.5	3.8	4.0	4.3	4.6	0:14
	ALT (FT)	11000	9000	9000	9000	9000	
100	FUEL (1000 LB)	5.4	5.7	6.0	6.4	6.8	0:22
	ALT (FT)	17000	17000	17000	15000	15000	
150	FUEL (1000 LB)	7.1	7.5	8.0	8.5	9.0	0:30
	ALT (FT)	21000	21000	21000	21000	19000	
200	FUEL (1000 LB)	8.6	9.1	9.7	10.4	11.0	0:36
	ALT (FT)	29000	25000	25000	23000	23000	
250	FUEL (1000 LB)	10.0	10.7	11.4	12.2	13.0	0:43
	ALT (FT)	31000	29000	27000	27000	25000	
300	FUEL (1000 LB)	11.3	12.2	13.1	13.9	14.9	0:48
	ALT (FT)	37000	35000	31000	29000	27000	
350	FUEL (1000 LB)	12.5	13.5	14.6	15.6	16.7	0:54
	ALT (FT)	39000	37000	35000	31000	29000	
400	FUEL (1000 LB)	13.7	14.9	16.1	17.3	18.5	1:00
	ALT (FT)	39000	37000	35000	33000	31000	
450	FUEL (1000 LB)	15.0	16.3	17.6	18.9	20.3	1:06
	ALT (FT)	39000	37000	35000	33000	31000	
500	FUEL (1000 LB)	16.2	17.6	19.1	20.6	22.1	1:13
	ALT (FT)	41000	37000	35000	33000	31000	

Holding Planning Flaps Up

WEIGHT (1000 LB)	TOTAL FUEL FLOW (LB/HR)									
	PRESSURE ALTITUDE (FT)									
	1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
660	19330	19010	18750	18570	19100	19500	20510			
620	18120	17920	17630	17320	17650	18150	18860			
580	17220	17070	16770	16380	16200	16850	17340	18550		
540	16100	15890	15690	15270	15110	15570	15920	16790		
500	15010	14740	14610	14190	13860	14190	14590	15210		
460	13930	13670	13490	13130	12760	12800	13330	13690	15160	
420	12860	12620	12370	12090	11790	11770	12050	12300	13340	
380	11810	11580	11320	11060	10850	10610	10850	11020	11700	12440
340	10800	10550	10320	10050	9910	9610	9540	9850	10220	10760

Flaps 1

WEIGHT (1000 LB)	TOTAL FUEL FLOW (LB/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
660	20100	19880	19700	19200	19370
620	18840	18630	18490	17990	17990
580	17910	17670	17470	17040	16580
540	16710	16460	16270	15860	15590
500	15510	15260	15070	14720	14440
460	14320	14090	13880	13580	13320
420	13140	12930	12720	12460	12240
380	11970	11770	11590	11350	11190
340	10850	10640	10470	10270	10160

These tables include 5% additional fuel for holding in a racetrack pattern.

Crew Oxygen Requirements

Required Pressure (PSI) for One 114/115 Cubic Ft. Cylinder

BOTTLE TEMPERATURE		NUMBER OF CREW USING OXYGEN		
°C	°F	2	3	4
50	122	530	735	945
45	113	520	725	930
40	104	510	715	915
35	95	505	700	900
30	86	495	690	885
25	77	485	680	870
20	68	480	670	860
15	59	470	655	840
10	50	460	645	830
5	41	455	635	815
0	32	445	620	800
-5	23	440	610	785
-10	14	430	600	770

For more extensive than normal crew usage, add 1.2 psi/person/minute.

ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 LB)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
27	351.2	347.7	
26	365.9	363.7	350.5
25	380.6	380.3	365.9
24	395.8	393.6	378.6
23	411.3	407.3	391.9
22	427.4	421.2	405.6
21	444.0	435.3	419.4
20	460.9	449.9	433.4
19	486.0	468.2	447.7
18	512.1	487.1	461.8
17	532.5	506.1	478.7
16	553.5	525.6	495.9
15	575.1	545.8	513.5
14	597.4	566.5	531.4
13	621.6	589.5	554.4
12	646.5	613.4	578.3
11	654.0	620.6	585.8
10	661.1	623.5	590.8
9	675.1	637.0	603.6
8	686.8	649.8	616.1
7	697.7	661.9	628.7
6	709.0	673.1	641.3
5	715.0	683.9	653.5
4	715.0	693.8	663.6

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 LB)											
	PRESSURE ALTITUDE (1000 FT)											
	6	8	10	12	14	16	18	20	22	24	26	
ENGINE ONLY	-12.6	-9.2	-7.6	-5.7	-4.4	-5.1	-6.2	-7.4	-7.2	-7.1	-6.7	
ENGINE AND WING	-19.6	-15.8	-13.0	-10.2	-8.6	-9.2	-10.3	-11.9	-11.6	-11.2	-10.3	

ALL ENGINES

Decompression Critical Fuel Reserves - LRC Cruise Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEAD WIND COMPONENT (KTS)						TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
278	258	241	225	212	200	189	180	171	163	156
569	525	487	454	425	400	378	358	340	323	308
860	791	733	682	639	600	566	535	508	483	461
1151	1058	979	911	852	800	754	713	676	643	613
1442	1325	1225	1140	1065	1000	942	891	845	803	765
1733	1591	1471	1368	1279	1200	1130	1069	1013	963	918
2024	1858	1718	1597	1492	1400	1319	1246	1182	1123	1070
2315	2125	1964	1825	1705	1600	1507	1424	1350	1283	1223
2606	2392	2210	2054	1919	1800	1695	1602	1518	1443	1375
2897	2658	2456	2283	2132	2000	1883	1780	1687	1603	1527
3188	2925	2702	2511	2345	2200	2072	1957	1855	1763	1680
3479	3192	2949	2740	2559	2400	2260	2135	2024	1923	1832
3770	3459	3195	2968	2772	2600	2448	2313	2192	2083	1984
4061	3725	3441	3197	2985	2800	2636	2491	2360	2243	2137
4352	3992	3687	3426	3199	3000	2825	2668	2529	2403	2289

Critical Fuel (1000 LB)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 LB)								
	340	380	420	460	500	540	580	620	660
200	9.6	10.1	10.6	11.1	11.5	12.0	12.4	12.9	13.3
400	17.8	18.7	19.6	20.3	21.0	21.9	22.7	23.4	24.1
600	25.9	27.1	28.4	29.4	30.4	31.5	32.6	33.6	34.6
800	33.6	35.3	37.0	38.4	39.7	41.1	42.5	43.8	45.1
1000	41.3	43.5	45.5	47.4	48.9	50.6	52.4	54.1	55.6
1200	49.0	51.6	54.1	56.3	58.2	60.1	62.3	64.3	66.1
1400	56.8	59.8	62.7	65.3	67.3	69.5	72.0	74.2	76.3
1600	64.5	67.8	70.9	73.8	76.3	78.8	81.5	84.1	86.5
1800	72.2	75.5	79.1	82.4	85.3	88.0	91.0	94.0	96.7
2000	80.0	83.2	87.3	91.0	94.2	97.3	100.6	103.9	106.9
2200	87.7	91.0	95.4	99.6	103.2	106.5	109.9	113.5	116.8
2400	95.4	98.7	103.6	108.0	111.8	115.5	119.2	123.0	126.7
2600	103.1	106.4	111.4	116.1	120.4	124.4	128.5	132.5	136.6
2800	110.9	114.1	119.1	124.3	129.0	133.4	137.7	142.1	146.4
3000	118.6	121.9	126.8	132.5	137.6	142.4	146.9	151.4	155.9

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included.

Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required 0.8% per 10°C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (2%) for the total forecast time or engine and wing anti-ice on and ice drag (6%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engine cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

ENGINE INOP

**Decompression Critical Fuel Reserves - LRC Cruise
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEAD WIND COMPONENT (KTS)						TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
284	262	243	227	213	200	189	179	170	162	154
577	530	490	456	426	400	377	356	338	321	306
871	799	738	685	640	600	565	534	506	481	458
1164	1067	985	914	853	800	753	711	674	640	609
1457	1335	1232	1143	1067	1000	941	889	842	799	761
1750	1603	1479	1373	1281	1200	1129	1066	1010	959	913
2043	1871	1726	1602	1494	1400	1317	1243	1178	1118	1065
2337	2140	1973	1831	1708	1600	1505	1421	1346	1278	1217
2630	2408	2220	2060	1921	1800	1693	1598	1513	1437	1368
2923	2676	2467	2289	2135	2000	1881	1776	1681	1597	1520
3216	2944	2715	2518	2348	2200	2069	1953	1849	1756	1672
3509	3212	2962	2747	2562	2400	2257	2131	2017	1916	1824
3803	3481	3209	2977	2776	2600	2445	2308	2185	2075	1975
4096	3749	3456	3206	2989	2800	2633	2485	2353	2234	2127
4389	4017	3703	3435	3203	3000	2821	2663	2521	2394	2279

Critical Fuel (1000 LB)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 LB)								
	340	380	420	460	500	540	580	620	660
200	9.1	9.5	10.0	10.5	11.0	11.6	12.1	12.7	13.3
400	16.8	17.6	18.4	19.3	20.3	21.3	22.3	23.3	24.4
600	24.5	25.5	26.7	28.0	29.3	30.7	32.1	33.5	35.0
800	31.8	33.3	34.7	36.4	38.1	39.9	41.7	43.7	45.6
1000	39.1	41.0	42.8	44.8	46.9	49.2	51.4	53.8	56.3
1200	46.4	48.7	50.8	53.2	55.8	58.4	61.1	63.9	66.8
1400	53.8	56.4	58.8	61.6	64.6	67.5	70.5	73.6	76.9
1600	61.1	64.1	66.7	69.7	73.0	76.3	79.8	83.3	87.1
1800	68.4	71.4	74.5	77.7	81.4	85.2	89.0	93.0	97.2
2000	75.7	78.7	82.2	85.8	89.8	94.0	98.3	102.7	107.2
2200	83.1	86.0	89.9	93.8	98.1	102.8	107.4	112.0	116.9
2400	90.4	93.4	97.6	101.8	106.4	111.3	116.2	121.3	126.6
2600	97.7	100.7	105.2	109.6	114.5	119.7	125.0	130.5	136.3
2800	105.0	108.0	112.5	117.4	122.5	128.0	133.8	139.8	145.9
3000	112.4	115.3	119.9	125.1	130.5	136.4	142.6	148.8	155.1

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required 0.8% per 10°C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (2%) for the total forecast time or engine and wing anti-ice on and ice drag (8%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

ENGINE INOP

Driftdown Critical Fuel Reserves - LRC Driftdown/Cruise Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
265	249	234	221	210	200	190	182	174	167	160
533	499	470	444	421	400	380	363	347	333	320
803	752	707	667	632	600	571	544	520	498	478
1075	1006	945	891	843	800	760	725	693	663	636
1350	1261	1184	1115	1054	1000	950	906	865	828	794
1626	1518	1423	1340	1266	1200	1140	1086	1036	992	950
1903	1775	1664	1565	1478	1400	1329	1266	1208	1155	1107
2181	2033	1904	1791	1690	1600	1518	1445	1379	1318	1263
2461	2292	2145	2016	1902	1800	1708	1625	1550	1481	1418
2741	2552	2387	2242	2114	2000	1897	1804	1720	1644	1574
3021	2811	2628	2468	2326	2200	2086	1984	1891	1806	1729
3301	3071	2870	2694	2538	2400	2275	2163	2062	1969	1885
3582	3330	3111	2920	2750	2600	2464	2343	2232	2132	2040
3861	3589	3353	3145	2962	2800	2654	2522	2403	2295	2196
4140	3848	3594	3371	3174	3000	2843	2702	2574	2458	2352

Critical Fuel (1000 LB)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 LB)								
	340	380	420	460	500	540	580	620	660
200	9.9	10.3	10.7	11.2	11.7	12.2	12.5	13.0	13.5
400	16.1	17.1	18.1	19.2	20.3	21.4	22.4	23.6	24.6
600	21.9	23.5	25.1	26.9	28.6	30.3	31.9	33.6	35.3
800	27.6	29.8	32.0	34.3	36.7	39.0	41.3	43.5	45.8
1000	33.2	36.0	38.8	41.7	44.6	47.6	50.4	53.3	56.1
1200	38.7	42.0	45.4	48.9	52.4	56.0	59.4	62.8	66.2
1400	44.0	48.0	51.9	56.0	60.1	64.2	68.2	72.2	76.2
1600	49.3	53.8	58.3	63.0	67.7	72.4	77.0	81.5	86.1
1800	54.5	59.5	64.6	69.9	75.2	80.4	85.6	90.7	95.8
2000	59.6	65.2	70.9	76.7	82.5	88.4	94.0	99.7	105.4
2200	64.6	70.7	77.0	83.4	89.8	96.2	102.4	108.6	114.8
2400	69.5	76.2	83.0	90.0	97.0	103.9	110.7	117.4	124.2
2600	74.4	81.6	89.0	96.6	104.1	111.6	118.9	126.2	133.4
2800	79.3	87.0	94.9	103.0	111.1	119.1	126.9	134.8	142.6
3000	84.0	92.2	100.7	109.4	118.0	126.6	134.9	143.3	151.6

Based on: Driftdown to and cruise at level off altitude, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required 0.8% per 10°C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (2%) for the total forecast time or engine and wing anti-ice on and ice drag (10%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

Intentionally
Blank

Performance Dispatch Landing

Chapter PD Section 52

Landing Field Limit Weight

Flaps 30

Wind Adjusted Field Length (FT)

FIELD LENGTH AVAILABLE (FT)	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
3000			2650	3000	3210	3430	3640	3850
3400		2690	3010	3400	3610	3840	4070	4310
3800	2740	3030	3370	3800	4010	4250	4500	4770
4200	3070	3380	3740	4200	4420	4670	4930	5230
4600	3400	3730	4110	4600	4840	5100	5380	5680
5000	3730	4080	4480	5000	5250	5530	5820	6140
5400	4060	4430	4850	5400	5670	5960	6270	6600
5800	4390	4790	5220	5800	6090	6390	6710	7050
6200	4720	5140	5590	6200	6500	6820	7160	7510
6600	5050	5490	5960	6600	6920	7250	7610	7980
7000	5380	5850	6330	7000	7330	7680	8050	8440
7400	5710	6200	6700	7400	7740	8110	8520	8960
7800	6040	6550	7070	7800	8150	8550	8990	9470
8200	6370	6900	7440	8200	8560	8980	9450	9990
8600	6710	7260	7820	8600	8970	9410	9920	10500
9000	7040	7610	8190	9000	9390	9860	10400	11020
9400	7370	7960	8560	9400	9820	10310	10880	11510
9800	7660	8280	8920	9800	10250	10760	11350	12010
10200	7930	8590	9280	10200	10670	11210	11820	12500
10600	8200	8900	9640	10600	11100	11660	12290	12990

Landing Field Limit Weight

Flaps 30

Field Limit Weight (1000 LB)

WIND CORRECTED FIELD LENGTH (FT)	AIRPORT PRESSURE ALTITUDE (FT)							
	0		1000		2000		3000	
	DRY	WET	DRY	WET	DRY	WET	DRY	WET
4200	346.2		335.8		325.4			
4600	390.2	324.3	378.6		367.1		356.0	
5000	434.8	362.4	422.0	351.6	409.2	340.8	396.9	330.4
5400	480.1	400.8	465.9	389.0	451.8	377.1	438.3	365.7
5800	509.6	439.7	500.5	426.8	491.3	413.8	478.4	401.4
6200	536.0	479.1	526.4	465.0	516.8	450.9	507.4	437.4
6600	561.8	505.4	551.8	495.6	541.7	485.9	531.9	472.5
7000	587.0	528.6	576.5	519.1	566.0	509.6	555.7	500.4
7400	611.5	551.3	600.6	541.4	589.7	531.5	579.0	521.8
7800	635.6	573.4	624.2	563.1	612.9	552.9	601.8	542.8
8200	658.7	595.0	647.1	584.4	635.5	573.8	624.1	563.4
8600	678.0	616.3	667.7	605.3	657.4	594.3	645.7	583.5
9000	696.3	637.1	686.1	625.7	675.9	614.4	665.2	603.2
9400	711.2	657.2	701.3	645.6	691.4	634.1	681.0	622.6
9800	724.1	674.3	714.1	663.8	704.2	653.2	693.7	641.5
10200		690.4	726.5	680.3	716.1	670.2	705.7	659.0
10600		705.3		695.3	727.9	685.3	717.2	674.9
11000		716.5		706.7		696.9	728.5	686.4
11400		727.7		717.6		707.5		697.1
11800				728.4		717.9		707.5
12200						728.2		717.5
12600								727.3

With manual speedbrakes, decrease weight by 36800 lb.

With 1 brake deactivated, decrease weight by 36200 lb.

With 2 brakes deactivated, decrease weight by 73800 lb.

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 LB)			
		AIRPORT PRESSURE ALTITUDE (FT)			
°C	°F	0	1000	2000	3000
54	129	509.5			
52	126	524.1	504.0		
50	122	539.1	519.0	497.5	
48	118	555.3	533.9	512.5	493.3
46	115	571.0	549.5	526.9	506.8
44	111	586.0	564.3	541.8	520.4
42	108	600.7	578.4	555.9	533.9
40	104	614.6	591.8	569.1	546.8
38	100	628.0	604.4	581.5	559.3
36	97	640.3	616.1	592.9	570.6
34	93	651.1	627.0	603.2	581.0
32	90	660.2	636.1	612.5	588.7
30	86	668.7	644.0	619.6	596.1
28	82	668.8	651.9	625.1	601.9
26	79	668.9	652.0	630.4	606.1
24	75	669.0	652.2	633.1	610.0
22	72	669.2	652.3	633.3	612.9
20	68	669.3	652.4	633.4	615.3
18	64	669.4	652.5	633.5	615.4
16	61	669.5	652.6	633.6	615.5
14	57	669.6	652.8	633.7	615.6
12	54	669.8	652.9	633.8	615.7
10 & BELOW	50 & BELOW	669.9	653.0	634.0	615.9

Based on engine bleed for 2 packs on and engine anti-ice on or off and wing anti-ice off.

With engine bleed for packs off, increase weight by 4800 lb.

With engine anti-ice on, decrease weight by 1100 lb.

With engine and wing anti-ice on, decrease weight by 4800 lb.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 43300 lb.

ENGINE INOP

ADVISORY INFORMATION

Go-Around Climb Gradient

Flaps 20, Gear Up

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.

OAT (°C)	REFERENCE GO-AROUND GRADIENT (%)					
	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
54	2.93					
50	3.70	2.65				
46	4.45	3.41	2.39			
42	5.18	4.08	3.02	2.05		
38	5.86	4.72	3.59	2.63	1.69	
34	6.46	5.24	4.12	3.08	2.12	1.21
39	6.87	5.62	4.48	3.42	2.36	1.36
26	6.88	5.89	4.70	3.60	2.53	1.49
22	6.88	5.95	4.83	3.73	2.66	1.62
18	6.89	5.96	4.97	3.85	2.77	1.74
14	6.89	5.97	5.01	3.98	2.89	1.84
10	6.90	5.97	5.02	4.05	3.01	1.94

Weight Adjustment

WEIGHT (1000 LB)	REFERENCE GO-AROUND GRADIENT (%)						
	1	2	3	4	5	6	7
650	-3.13	-3.53	-3.89	-4.23	-4.57	-4.90	-5.21
600	-2.58	-2.89	-3.19	-3.46	-3.74	-4.00	-4.26
550	-1.91	-2.12	-2.34	-2.53	-2.73	-2.93	-3.12
500	-1.06	-1.19	-1.30	-1.41	-1.52	-1.63	-1.74
450	0.00	0.00	0.00	0.00	0.00	0.00	0.00
400	1.35	1.49	1.62	1.76	1.90	2.06	2.21
350	3.10	3.40	3.71	4.03	4.36	4.72	5.10

Speed Adjustment

SPEED (KIAS)	WEIGHT ADJUSTED GO-AROUND GRADIENT (%)							
	1	2	3	4	5	6	7	8
VREF	-0.30	-0.31	-0.32	-0.33	-0.34	-0.34	-0.34	-0.34
VREF+5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VREF+10	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24
VREF+20	0.55	0.54	0.53	0.52	0.50	0.49	0.47	0.45
VREF+30	0.63	0.60	0.55	0.49	0.44	0.39	0.35	0.32

With engine bleed for packs off, increase gradient by 0.1%.

With engine and wing anti-ice on, decrease gradient by 0.1%.

When operating in icing conditions during any part of the flight with forecast landing temperatures below 10°C, decrease gradient by 0.6%.

Quick Turnaround Limit Weight

Flaps 30 Limit Weight (1000 LB)

AIRPORT OAT		PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	512				
50	122	516	496			
45	113	520	500	481		
40	104	525	504	484	466	
35	95	530	509	489	470	452
30	86	534	513	493	474	456
25	77	539	518	497	478	460
20	68	544	523	502	482	464
15	59	550	528	507	486	468
10	50	555	533	512	491	472
5	41	560	538	517	496	476
0	32	566	544	522	501	480
-5	23	572	549	527	506	485
-10	14	578	555	533	511	490
-15	5	584	561	538	516	495
-20	-4	591	567	544	522	500
-30	-22	604	580	556	534	511
-40	-40	618	594	570	546	523
-50	-58	633	608	584	560	536
-54	-65	640	614	589	565	541

Increase weight by 4800 lb per 1% uphill slope. Decrease weight by 10700 lb per 1% downhill slope.

Increase weight by 13000 lb per 10 knots headwind. Decrease weight by 74000 lb per 10 knots tailwind.

Decrease weight by 28000 lb when one brake is deactivated. Decrease weight by 57300 lb when two brakes are deactivated.

After landing at weights exceeding those shown above, adjusted for slope and wind, wait at least 65 minutes and check that wheel thermal plugs have not melted before executing a takeoff.

As an alternate procedure, no waiting period is required if the BRAKE TEMP advisory message on EICAS is not displayed 10 to 15 minutes after parking.

Intentionally
Blank

Performance Dispatch

Chapter PD

Gear Down

Section 53

GEAR DOWN

Takeoff Climb Limit Weight

AIRPORT OAT		TAKEOFF CLIMB WEIGHT (1000 LB)			
		AIRPORT PRESSURE ALTITUDE (FT)			
°C	°F	0	1000	2000	3000
54	129	369.1	361.1	358.5	355.6
52	126	378.8	363.3	358.5	355.4
50	122	388.5	374.1	360.7	355.4
48	118	398.2	384.9	371.0	357.6
46	115	408.3	395.5	381.6	367.5
44	111	418.0	406.3	391.5	377.0
42	108	427.0	416.2	401.2	386.5
40	104	435.8	425.5	410.9	395.9
38	100	444.7	434.7	420.0	405.0
36	97	453.5	443.6	428.8	413.8
34	93	462.5	451.9	436.7	422.4
32	90	471.6	459.9	444.4	429.9
30	86	480.4	467.2	451.7	437.2
28	82	489.6	474.0	457.9	443.3
26	79	498.2	481.7	464.1	448.9
24	75	502.6	489.0	470.7	454.1
22	72	502.6	492.3	477.1	459.9
20	68	502.6	492.3	480.2	465.6
18	64	502.6	492.3	480.2	468.0
16	61	502.6	492.3	480.2	468.0
14	57	502.6	492.3	479.9	468.0
12	54	502.9	492.3	479.9	468.0
10	50	502.9	492.3	479.9	468.0

With engine anti-ice on, decrease weight by 17000 lb.
With engine and wing anti-ice on, decrease weight by 23100 lb.

GEAR DOWN

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 LB)			
		AIRPORT PRESSURE ALTITUDE (FT)			
°C	°F	0	1000	2000	3000
54	129	439.8			
52	126	452.1	435.0		
50	122	464.7	447.8	429.5	
48	118	478.5	460.6	442.5	426.2
46	115	491.7	473.6	454.8	437.8
44	111	504.3	485.9	467.1	449.3
42	108	516.7	497.6	478.7	460.3
40	104	528.6	509.1	489.7	470.9
38	100	540.4	520.0	500.4	481.3
36	97	551.1	530.0	510.1	490.9
34	93	560.0	539.0	518.4	499.5
32	90	567.8	546.8	526.3	506.0
30	86	575.2	553.7	532.6	512.3
28	82	575.3	560.2	537.3	517.0
26	79	575.4	560.3	541.7	520.4
24	75	575.6	560.4	544.0	523.6
22	72	575.7	560.5	544.1	526.0
20	68	575.7	560.6	544.2	528.0
18	64	575.8	560.7	544.3	528.1
16	61	575.9	560.8	544.3	528.1
14	57	576.0	560.9	544.4	528.2
12	54	576.2	561.0	544.5	528.3
10	50	576.3	561.1	544.6	528.4
-40	-40	578.0	562.8	546.3	530.0

Based on engine bleed for 2 packs on, APU on or off, engine anti-ice off and wing anti-ice off.

With engine bleed for packs off, increase weight by 4000 lb.

With engine anti-ice on, decrease weight by 1000 lb.

With engine and wing anti-ice on, decrease weight by 4200 lb.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 57600 lb.

GEAR DOWN

Takeoff Obstacle Limit Weight

Flaps 15

Sea Level, 30°C & Below, Zero Wind

OBSTACLE HEIGHT (FT)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 LB)								
	DISTANCE FROM BRAKE RELEASE (1000 FT)								
	8	10	12	14	16	18	20	22	24
10	506.0	542.7	573.4	598.1					
50	484.0	517.4	544.5	566.1	582.9	595.6			
100	455.7	494.1	520.0	540.9	557.8	571.3	582.0	590.6	597.5
150	431.8	474.1	500.6	521.5	538.5	552.5	564.0	573.5	581.3
200	412.1	453.8	484.4	505.1	522.3	536.8	548.8	558.8	567.3
250	395.1	436.0	468.0	490.8	508.2	522.9	535.3	545.9	554.9
300	380.0	420.4	452.4	477.6	495.4	510.4	523.2	534.1	543.6
350	366.5	406.5	438.3	464.0	484.0	499.0	512.0	523.3	533.1
400	354.3	393.8	425.5	451.3	472.3	488.5	501.7	513.3	523.3
450	343.1	382.2	413.7	439.6	461.0	478.6	492.1	503.9	514.2
500	343.9	371.4	402.9	428.7	450.3	468.4	483.2	495.0	505.6
550		361.4	392.7	418.6	440.3	458.6	474.1	486.8	497.4
600		352.1	383.2	409.1	430.9	449.4	465.2	478.7	489.7
650		343.4	374.3	400.2	422.0	440.7	456.7	470.5	482.3
700			365.9	391.7	413.6	432.4	448.6	462.6	474.8
750			357.9	383.7	405.6	424.5	440.8	455.0	467.5
800			350.3	376.0	398.0	416.9	433.4	447.8	460.4
850			343.2	368.8	390.7	409.7	426.2	440.8	453.6
900				361.8	383.8	402.8	419.4	434.0	447.0
950				355.2	377.1	396.2	412.9	427.6	440.6
1000				348.8	370.7	389.8	406.5	421.3	434.5

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustments

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 LB)							
	340	380	420	460	500	540	580	620
30 & Below	0	0	0	0	0	0	0	0
32	-4.9	-5.6	-6.4	-7.2	-7.9	-8.7	-9.4	-10.2
34	-9.8	-11.3	-12.8	-14.3	-15.8	-17.3	-18.8	-20.3
36	-14.7	-16.9	-19.2	-21.5	-23.7	-26.0	-28.2	-30.5
38	-19.6	-22.6	-25.6	-28.6	-31.6	-34.6	-37.6	-40.6
40	-24.5	-28.2	-32.0	-35.8	-39.5	-43.3	-47.0	-50.8
42	-31.6	-36.4	-41.2	-45.9	-50.7	-55.5	-60.2	-65.0
44	-38.7	-44.5	-50.3	-56.1	-61.9	-67.7	-73.5	-79.2
46	-45.9	-52.7	-59.5	-66.3	-73.1	-79.9	-86.7	-93.5
48	-53.0	-60.8	-68.6	-76.4	-84.2	-92.1	-99.9	-107.7
50	-60.1	-68.9	-77.8	-86.6	-95.4	-104.3	-113.1	-121.9

Pressure Altitude Adjustments

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 LB)							
	340	380	420	460	500	540	580	620
S.L. & Below	0	0	0	0	0	0	0	0
1000	-12.7	-14.2	-15.6	-17.1	-18.6	-20.0	-21.5	-23.0
2000	-26.6	-29.5	-32.3	-35.2	-38.0	-40.9	-43.7	-46.5
3000	-39.8	-44.1	-48.3	-52.6	-56.8	-61.1	-65.3	-69.6

GEAR DOWN

Takeoff Obstacle Limit Weight

Flaps 15

Wind Adjustments

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 LB)							
	340	380	420	460	500	540	580	620
15 TW	-54.4	-51.7	-49.0	-46.4	-43.7	-41.0	-38.4	-35.7
10 TW	-36.3	-34.5	-32.7	-30.9	-29.1	-27.4	-25.6	-23.8
5 TW	-18.1	-17.2	-16.3	-15.5	-14.6	-13.7	-12.8	-11.9
0	0	0	0	0	0	0	0	0
10 HW	8.0	7.2	6.3	5.5	4.7	3.8	3.0	2.2
20 HW	16.0	14.3	12.7	11.0	9.3	7.7	6.0	4.3
30 HW	24.0	21.7	19.3	17.0	14.7	12.3	10.0	7.7
40 HW	32.0	29.0	26.0	23.0	20.0	17.0	14.0	11.0

With engine bleed for packs off, increase weight by 300 lb.

With engine anti-ice on, decrease weight by 2400 lb.

With engine and wing anti-ice on, decrease weight by 3500 lb.

Long Range Cruise Altitude Capability

Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
660	14400	14300	12000
640	15800	15700	13600
620	17100	17000	15100
600	18400	18300	16500
580	19700	19600	17900
560	20800	20700	19300
540	21900	21800	20500
520	23000	22900	21700
500	24200	24100	22800
480	25300	25200	24000
460	26300	26100	25100
440	27300	27100	26200
420	28300	28000	27200
400	29400	29100	28300
380	30600	30100	29400
360	31500	31200	30600
340	32200	31900	31500

GEAR DOWN

**Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
323	289	260	236	217	200	187	175	165	156	148
483	433	389	354	325	300	281	263	248	234	222
642	576	518	472	434	400	375	352	331	313	297
800	718	647	590	542	500	468	440	414	391	372
958	860	775	707	650	600	562	528	497	470	447
1115	1002	904	824	758	700	656	616	581	549	522
1272	1143	1031	941	866	800	750	705	664	628	597
1428	1284	1159	1058	974	900	844	793	747	707	672
1583	1424	1286	1174	1082	1000	938	881	830	786	747
1737	1564	1413	1291	1189	1100	1032	970	914	865	823
1891	1703	1540	1408	1297	1200	1126	1058	998	944	898
2045	1842	1667	1524	1405	1300	1219	1146	1081	1023	973
2198	1981	1793	1640	1513	1400	1313	1235	1165	1103	1049
2350	2120	1920	1757	1620	1500	1408	1324	1249	1183	1125
2502	2258	2046	1873	1728	1600	1502	1413	1333	1263	1201
2653	2396	2171	1988	1835	1700	1596	1501	1417	1342	1276
2804	2533	2297	2104	1943	1800	1690	1590	1500	1421	1352
2955	2671	2423	2220	2050	1900	1784	1679	1585	1501	1429
3105	2808	2548	2336	2157	2000	1878	1768	1669	1581	1505
3254	2944	2673	2451	2265	2100	1973	1857	1753	1661	1581
3403	3080	2797	2566	2372	2200	2067	1946	1837	1741	1657

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	18.2	0:50	17.3	0:49	16.8	0:47	16.7	0:46	17.1	0:46
300	26.6	1:13	25.2	1:10	24.1	1:08	23.7	1:06	24.1	1:06
400	35.0	1:35	33.0	1:31	31.5	1:28	30.8	1:25	31.2	1:25
500	43.5	1:57	41.0	1:52	38.9	1:48	38.0	1:45		
600	52.1	2:19	48.9	2:13	46.4	2:09	45.2	2:04		
700	60.8	2:41	57.1	2:34	54.1	2:29	52.6	2:23		
800	69.5	3:03	65.2	2:55	61.7	2:49	60.0	2:43		
900	78.3	3:24	73.5	3:16	69.5	3:08	67.6	3:02		
1000	87.2	3:46	81.8	3:36	77.4	3:28	75.3	3:21		
1100	96.3	4:07	90.3	3:57	85.4	3:48	83.1	3:39		
1200	105.3	4:28	98.8	4:17	93.4	4:07	90.9	3:58		
1300	114.6	4:49	107.4	4:37	101.5	4:27	99.0	4:17		
1400	123.8	5:10	116.0	4:57	109.7	4:46	107.1	4:36		
1500	133.2	5:30	124.9	5:17	118.1	5:06				
1600	142.7	5:51	133.7	5:37	126.5	5:25				
1700	152.3	6:12	142.7	5:57	135.1	5:44				
1800	161.9	6:32	151.7	6:16	143.7	6:03				
1900	171.7	6:52	160.8	6:36	152.6	6:22				
2000	181.5	7:12	170.0	6:55	161.4	6:41				
2100	191.5	7:32	179.4	7:15	170.5	7:00				
2200	201.5	7:52	188.8	7:34	179.5	7:19				

GEAR DOWN

Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	LANDING WEIGHT (1000 LB)				
	350	400	450	500	550
20	-2.4	-1.2	0.0	1.6	3.3
40	-4.6	-2.3	0.0	3.2	6.6
60	-6.7	-3.4	0.0	4.8	10.1
80	-8.9	-4.5	0.0	6.5	13.7
100	-11.2	-5.6	0.0	8.2	17.4
120	-13.5	-6.8	0.0	10.1	21.3
140	-15.8	-8.0	0.0	12.0	25.4
160	-18.1	-9.2	0.0	14.0	29.7
180	-20.5	-10.4	0.0	16.0	34.0
200	-22.9	-11.7	0.0	18.2	38.6
220	-25.4	-12.9	0.0	20.4	43.3
240	-27.9	-14.2	0.0	22.6	48.2
260	-30.4	-15.5	0.0	24.9	53.2

Based on VREF+80 climb, Long Range Cruise and VREF+80 descent.

GEAR DOWN

**Short Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
99	83	71	62	55	50	46	42	39	36	33
174	152	134	121	109	100	92	85	80	75	70
249	220	197	178	163	150	139	129	121	114	107
323	287	259	236	216	200	186	174	163	153	145
396	354	321	293	270	250	233	218	205	193	183
468	421	382	350	323	300	280	262	247	233	221
541	488	444	407	377	350	327	307	289	273	259
614	554	506	465	430	400	374	351	331	313	297
687	622	568	522	483	450	421	395	373	353	335
762	690	630	580	537	500	468	440	414	392	372

Trip Fuel and Time

AIR DISTANCE (NM)		LANDING WEIGHT (1000 LB)					TIME (HRS:MIN)
		300	350	400	450	500	
50	FUEL (1000 LB)	4.2	4.6	4.9	5.3	5.7	0:15
	ALT (FT)	14000	12000	10000	10000	8000	
100	FUEL (1000 LB)	7.2	7.8	8.5	9.2	9.9	0:26
	ALT (FT)	22000	18000	18000	16000	16000	
150	FUEL (1000 LB)	9.8	10.8	11.8	12.8	13.9	0:36
	ALT (FT)	26000	22000	20000	20000	18000	
200	FUEL (1000 LB)	12.3	13.7	15.0	16.4	17.8	0:46
	ALT (FT)	28000	26000	24000	22000	20000	
250	FUEL (1000 LB)	14.8	16.5	18.1	19.8	21.6	0:55
	ALT (FT)	30000	28000	24000	22000	20000	
300	FUEL (1000 LB)	17.3	19.3	21.3	23.3	25.5	1:05
	ALT (FT)	30000	28000	24000	22000	20000	
350	FUEL (1000 LB)	19.8	22.1	24.5	26.9	29.4	1:14
	ALT (FT)	30000	28000	26000	22000	20000	
400	FUEL (1000 LB)	22.3	24.9	27.7	30.4	33.3	1:24
	ALT (FT)	30000	28000	26000	22000	20000	
450	FUEL (1000 LB)	24.8	27.8	30.9	34.0	37.2	1:33
	ALT (FT)	30000	28000	26000	22000	20000	
500	FUEL (1000 LB)	27.3	30.6	34.1	37.6	41.2	1:43
	ALT (FT)	30000	28000	26000	22000	20000	

GEAR DOWN

**Holding Planning
Flaps Up**

WEIGHT (1000 LB)	TOTAL FUEL FLOW (LB/HR)						
	PRESSURE ALTITUDE (FT)						
	1500	5000	10000	15000	20000	25000	30000
660	30550	30000	30290	31040			
620	28790	28170	28320	28710			
580	27230	26590	26570	26740	28330		
540	25720	25160	24930	24950	25940		
500	24120	23720	23360	23190	23690		
460	22510	22210	21830	21490	21710	23080	
420	20910	20590	20290	19770	19850	20560	
380	19320	18980	18770	18150	18100	18490	20080
340	18050	17720	17440	16880	16410	16660	17400

Flaps 1

WEIGHT (1000 LB)	TOTAL FUEL FLOW (LB/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
660	29330	28790	29140	29660	
620	27540	26970	27120	27400	
580	25860	25370	25270	25430	26620
540	24250	23930	23630	23640	24270
500	22600	22330	22030	21840	22100
460	20980	20680	20460	20040	20160
420	19350	19040	18880	18300	18350
380	18020	17740	17510	16990	16620
340	16410	16160	15900	15460	15220

These tables include 5% additional fuel for holding in a racetrack pattern.
Do not hold at Flaps 1 in icing conditions.

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 LB)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
14	350.1	342.7	
12	377.2	372.0	366.0
10	395.9	389.9	383.5
8	419.6	412.0	404.3
6	443.6	433.7	424.0
4	466.7	453.2	440.3
2	487.9	470.6	453.6
0	503.1	475.5	

Anti-Ice Adjustments

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 LB)						
	PRESSURE ALTITUDE (1000 FT)						
	2	4	6	8	10	12	14
ENGINE ONLY	-14.3	-12.2	-10.4	-8.4	-7.1	-5.2	-4.0
ENGINE AND WING	-21.0	-18.1	-15.7	-13.1	-10.9	-8.6	-6.8

Intentionally
Blank

Performance Dispatch Text

Chapter PD Section 54

Introduction

This chapter contains self dispatch performance data intended primarily for use by flight crews in the event that information cannot be obtained from the airline dispatch office. The data provided is for a single takeoff flap at max takeoff thrust. The range of conditions covered is limited to those normally encountered in airline operation. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

Takeoff

The maximum allowable takeoff weight will be the least of the Field, Climb, Tire, Brake Energy and Obstacle Limit Weights as determined from the following tables.

Field Limit Weight - Slope and Wind Corrections

These tables provide corrections to the field length available for the effects of runway slope and wind component along the runway. Enter the Slope Correction table with the available field length and runway slope to determine the slope corrected field length. Now enter the Wind Correction table with slope corrected field length and wind component to determine the slope and wind corrected field length.

Field and Climb Limit Weight

Tables are presented for selected airport pressure altitudes and show both Field and Climb Limit Weights. Enter the appropriate table for pressure altitude with "Slope and Wind Corrected Field Length" determined above and airport OAT to obtain Field Limit Weight. Also read Climb Limit Weight for the same OAT. Intermediate altitudes may be interpolated or use next higher altitude.

Obstacle Limit Weight

This table provides obstacle limit weights for reference airport conditions based on obstacle height above the runway surface and distance from brake release. Enter the correction tables to correct the reference Obstacle Limit Weight for the effects of OAT, pressure altitude and wind as indicated. In the case of multiple obstacles, enter the tables successively with each obstacle and determine the most limiting weight.

Tire Speed Limit

Maximum tire speed limited weights are presented for 235 MPH tires. To determine the tire speed limit weight, enter the table with OAT, move to airport pressure altitude and read the tire speed limit weight. Adjust the tire speed limit weight according to the notes below the table to account for wind.

Brake Energy Limits VMBE

Tables are presented to determine the Maximum Brake Energy Speed VMBE. Compliance with this limitation is required to ensure that the brakes have enough capacity to execute a maximum effort stop from V1 without the use of thrust reversers. Enter the upper table with pressure altitude and OAT to determine the reference VMBE. Then enter the lower table with the reference VMBE and brake release weight to determine VMBE for a specific takeoff. Adjust for slope, wind and deactivated brakes as described below the table. The resulting VMBE must be greater than or equal to V1. If VMBE is less than V1, brake release weight must be decreased by the amount shown below the table.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table as well as FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Normal takeoff speeds, V1, VR, and V2 are read from the table by entering with takeoff flap setting and brake release weight. Use the tables provided to correct takeoff speeds for altitude and actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind corrections to V1 are obtained by entering the Slope and Wind V1 Adjustment Table.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Brakes Deactivated

When operating with brakes deactivated, the field and brake energy limit weights and the V1 and VMBE must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway limited weight by 8100 lb and the V1 associated with the reduced weight by one knot. With two brakes deactivated, reduce the normal runway limited weight by 17000 lb and the V1 associated with the reduced weight by three knots. If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate stop distance corrected for wind and slope exceeds approximately 4200 ft for one brake deactivated or 4400 ft for two brakes deactivated.

For brake(s) deactivated, reduce VMBE by the amount shown on the Brake Energy Limit VMBE Chart. If the resulting VMBE is less than V1, the brake release weight must be reduced according to the instructions on the brake energy limit chart. The resulting V1 must not be less than V1(MCG). Determine VR and V2 for the actual weight.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

Enroute

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination. Data is based on economy climb and descent speeds, and Long Range Cruise with normal engine bleed for air conditioning. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine trip fuel and time for a constant altitude cruise, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time Table with air distance from the Ground to Air Miles Conversion Table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment Table with the Reference Fuel and the planned landing weight to obtain fuel required at the planned landing weight.

Long Range Cruise Step Climb Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination when flying a step climb profile. Step climb profiles are based on 4000 ft step climbs to keep the flight within 2000 ft of the optimum altitude for the current cruise weight. To determine trip fuel and time, enter the Ground to Air Miles Conversion table and determine air distance as discussed above. Then enter the Trip Fuel and Time required with air distance and planned landing weight to read trip fuel. Continue across the table to read trip time.

Short Trip Fuel and Time

These tables are provided to determine trip fuel and time for short distances or alternates. The data considers the use of the FMC short trip optimum altitude. Obtain air distance from upper table using the ground distance and wind component to the alternate. Enter Trip Fuel and Time table with air distance and read trip fuel required for the expected landing weight, together with time to alternate at right. For distances greater than shown or other altitudes, use the Long Range Cruise Trip Fuel and Time tables.

Holding Planning

These tables provide total fuel flow information necessary for planning Flaps Up and Flaps 1 holding and reserve fuel requirements. Data is based on the FMC holding speed schedule which is the higher of the maximum endurance and flaps up maneuver speeds. As noted, the fuel flow is based on flight in a racetrack holding pattern. For holding in straight and level flight, reduce table values by 5%.

Oxygen Requirements

Flight Crew System

Regulations require that sufficient oxygen be provided to the flight crew to account for the greater of supplemental breathing oxygen in the event of a cabin depressurization or protective breathing in the event of smoke or harmful fumes in the flight deck. The oxygen quantity associated with these requirements is achieved with the minimum dispatch oxygen cylinder pressure. Enter the Crew Oxygen Requirements table with the number of crew plus observers using oxygen and read the minimum cylinder pressure required for the appropriate bottle temperature.

An additional quantity of oxygen is required when flight altitudes above 41000 ft are planned. Regulations require that one active duty pilot must don the oxygen mask and breathe diluted oxygen for the duration of the flight above 41000 ft. The additional quantity of oxygen required is 2.05 liters/person/minute (1.2 psi/person/minute for the single cylinder system), or 13 liters/person/minute (8 psi/person/minute) if 100% oxygen is selected during normal usage.

Net Level Off Weight

The Net Level Off Weight table is provided to determine terrain clearance capability in straight and level flight following an engine failure. Regulations require terrain clearance planning based on net performance

which is the gross (or actual) gradient performance degraded by 1.1%. In addition, the net level off pressure altitude must clear the terrain by 1000 ft.

To determine the maximum weight for terrain clearance, enter the table with required net level off pressure altitude and expected ISA deviation to obtain weight. Adjust weight for anti-ice operation as noted below the table.

Extended Range Operations

Regulations require that flights conducted over a route that contains a point further than one hour's time at "normal one engine inoperative speed" from an adequate diversion airport comply with rules set up specifically for "Extended Range Operation with Two Engine airplanes". This section provides reserve fuel planning information for the "Critical Fuel Scenario" based on two engine operation at Long Range Cruise as well as single engine operation at Long Range Cruise.

Critical Fuel Reserves

Enter Ground to Air Mile Conversion table with forecast wind and ground distance to diversion airport from critical point to obtain air distance. Now enter Critical Fuel table with air distance and expected weight at the critical point and read required fuel. Apply the noted fuel adjustments as necessary. Regulations require a 5% allowance for performance deterioration unless a value has been established by the operator for in-service deterioration.

As noted below each table, the fuel required is the greater of the two engine fuel and the single engine fuel. This fuel is compared to the amount of fuel normally onboard the airplane at that point in the route. If the fuel required by the critical fuel reserves exceeds the amount of fuel normally expected, the fuel load must be adjusted accordingly.

Landing

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for Flaps 30.

Maximum landing weight is the lowest of the field length limit weight, climb limit weight or maximum certified landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required.

Go-Around Climb Gradient

Enter the Reference Go-around Gradient table with airport OAT and pressure altitude to determine the reference Go-Around Gradient. Then adjust the reference gradient for airplane weight and speed using the tables provided to determine the weight and speed adjusted Go-Around Gradient. Apply the necessary engine bleed corrections as noted. Note that data is for one engine inoperative.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted adjustments as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent takeoff, or ensure the brake temperature is within limits using the alternate procedure described on the page.

Gear Down

This section provides flight planning data for revenue operation with gear down.

Takeoff/Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to determine Takeoff Climb Limit Weight with gear down. Correct the weight obtained for engine bleed configuration as required.

The remaining gear down tables in this section are identical in format and usage to the corresponding gear up tables previously described.

Intentionally
Blank

Performance Dispatch**Chapter PD****Table of Contents****Section 60****777-300ER GE90-115BL LB FAA**

Takeoff.....	PD.60.1
Takeoff Field Corrections - Dry Runway	PD.60.1
Takeoff Field & Climb Limit Weights - Dry Runway	PD.60.2
Takeoff Field Corrections - Wet Runway	PD.60.5
Takeoff Field & Climb Limit Weights - Wet Runway	PD.60.6
Takeoff Obstacle Limit Weight.....	PD.60.9
Tire Speed Limit	PD.60.11
Takeoff Speeds - Dry Runway	PD.60.12
Takeoff Speeds - Wet Runway	PD.60.14
 Enroute	 PD.61.1
Long Range Cruise Maximum Operating Altitude	PD.61.1
Long Range Cruise Trip Fuel and Time	PD.61.3
Long Range Cruise Step Climb	PD.61.5
Short Trip Fuel and Time	PD.61.6
Holding Planning	PD.61.7
Crew Oxygen Requirements.....	PD.61.7
Net Level Off Weight	PD.61.8
Decompression Critical Fuel Reserves - LRC Cruise	PD.61.9
Driftdown Critical Fuel Reserves - LRC Driftdown/Cruise.....	PD.61.11
 Landing	 PD.62.1
Landing Field Limit Weight - Dry Runway	PD.62.1
Landing Field Limit Weight - Wet Runway	PD.62.3
Landing Climb Limit Weight	PD.62.4
Go-Around Climb Gradient	PD.62.5
Quick Turnaround Limit Weight.....	PD.62.6
 Gear Down.....	 PD.63.1
Takeoff Climb Limit Weight.....	PD.63.1

Landing Climb Limit Weight	PD.63.2
Takeoff Obstacle Limit Weight	PD.63.3
Long Range Cruise Altitude Capability	PD.63.5
Long Range Cruise Trip Fuel and Time	PD.63.6
Short Trip Fuel and Time	PD.63.7
Holding Planning	PD.63.8
Net Level Off Weight	PD.63.9
Text.	PD.64.1
Introduction	PD.64.1
Takeoff	PD.64.1
Enroute	PD.64.4
Landing	PD.64.6
Gear Down	PD.64.7

Performance Dispatch

Chapter PD

Takeoff

Section 60

Takeoff Field Corrections - Dry Runway
Slope Corrections

FIELD LENGTH AVAILABLE (FT)	SLOPE CORRECTED FIELD LENGTH (FT)								
	RUNWAY SLOPE (%)								
	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
4200	4310	4280	4260	4230	4200	4150	4110	4060	4020
4600	4750	4710	4680	4640	4600	4540	4480	4420	4360
5000	5190	5140	5090	5050	5000	4930	4860	4780	4710
5400	5630	5570	5510	5460	5400	5310	5230	5140	5060
5800	6070	6000	5930	5870	5800	5700	5600	5500	5400
6200	6510	6430	6350	6280	6200	6090	5970	5860	5750
6600	6950	6860	6770	6690	6600	6470	6350	6220	6090
7000	7380	7290	7190	7100	7000	6860	6720	6580	6440
7400	7820	7720	7610	7510	7400	7250	7090	6940	6780
7800	8260	8150	8030	7920	7800	7630	7460	7300	7130
8200	8700	8580	8450	8330	8200	8020	7840	7660	7480
8600	9140	9010	8870	8740	8600	8410	8210	8020	7820
9000	9580	9440	9290	9150	9000	8790	8580	8370	8170
9400	10020	9860	9710	9550	9400	9180	8960	8730	8510
9800	10460	10290	10130	9960	9800	9560	9330	9090	8860
10200	10900	10720	10550	10370	10200	9950	9700	9450	9200
10600	11340	11150	10970	10780	10600	10340	10070	9810	9550
11000	11780	11580	11390	11190	11000	10720	10450	10170	9890
11400	12210	12010	11810	11600	11400	11110	10820	10530	10240
11800	12650	12440	12230	12010	11800	11500	11190	10890	10590

Wind Corrections

SLOPE CORR'D FIELD LENGTH (FT)	SLOPE & WIND CORRECTED FIELD LENGTH (FT)							
	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
4200	3170	3510	3860	4200	4450	4700	4970	5250
4600	3500	3870	4230	4600	4860	5130	5410	5700
5000	3840	4220	4610	5000	5270	5550	5850	6150
5400	4170	4580	4990	5400	5680	5980	6280	6600
5800	4500	4940	5370	5800	6100	6400	6720	7050
6200	4840	5290	5750	6200	6510	6830	7160	7490
6600	5170	5650	6120	6600	6920	7250	7590	7940
7000	5500	6000	6500	7000	7330	7680	8030	8390
7400	5840	6360	6880	7400	7750	8100	8470	8840
7800	6170	6710	7260	7800	8160	8530	8900	9290
8200	6500	7070	7630	8200	8570	8950	9340	9740
8600	6840	7420	8010	8600	8980	9370	9780	10190
9000	7170	7780	8390	9000	9390	9800	10210	10640
9400	7500	8140	8770	9400	9810	10220	10650	11090
9800	7840	8490	9150	9800	10220	10650	11090	11540
10200	8170	8850	9520	10200	10630	11070	11520	11990
10600	8500	9200	9900	10600	11040	11500	11960	12430
11000	8840	9560	10280	11000	11460	11920	12400	12880
11400	9170	9910	10660	11400	11870	12350	12840	13330
11800	9500	10270	11030	11800	12280	12770	13270	13780

Takeoff Field & Climb Limit Weights - Dry Runway**Flaps 15****Sea Level Pressure Altitude**

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)										
	OAT (°C)										
	-40	14	18	22	26	30	34	38	42	46	50
4600	549.2	495.8	492.5	489.3	486.1	483.0	473.2	461.4	448.3	434.8	421.2
5000	575.4	519.8	516.3	513.0	509.7	506.4	496.3	483.9	470.3	456.2	442.0
5400	600.5	542.7	539.2	535.7	532.3	528.9	518.3	505.5	491.3	476.7	462.0
5800	624.7	564.9	561.2	557.6	554.0	550.5	539.6	526.3	511.7	496.5	481.3
6200	647.9	586.2	582.4	578.6	575.0	571.4	560.1	546.3	531.2	515.6	499.9
6600	670.2	606.6	602.7	598.9	595.1	591.4	579.8	565.6	550.1	534.0	517.8
7000	691.6	626.3	622.3	618.3	614.5	610.7	598.7	584.2	568.2	551.7	535.1
7400	711.9	645.1	640.9	636.9	632.9	629.0	616.8	602.0	585.6	568.7	551.7
7800	731.5	663.2	659.0	654.9	650.8	646.9	634.4	619.2	602.5	585.2	567.8
8200	751.3	681.6	677.3	673.1	668.9	664.9	652.1	636.7	619.6	601.9	584.2
8600	770.2	699.1	694.7	690.4	686.2	682.1	669.1	653.3	635.9	617.9	599.8
9000	787.1	714.7	710.2	705.8	701.5	697.3	684.1	668.0	650.3	631.9	613.5
9400	802.6	728.8	724.3	719.8	715.4	711.2	697.7	681.3	663.2	644.5	625.8
9800	817.8	742.7	738.1	733.6	729.1	724.7	711.0	694.3	676.0	656.9	637.8
10200	832.6	756.3	751.6	747.0	742.4	738.0	724.0	707.1	688.4	669.0	649.6
10600	834.9	769.5	764.7	760.0	755.4	750.9	736.7	719.5	700.5	680.8	661.1
11000	834.9	782.4	777.5	772.8	768.1	763.5	749.1	731.6	712.3	692.3	672.2
CLIMB LIMIT WT (1000 LB)	823.3	823.2	822.9	822.6	822.3	821.9	794.3	763.1	728.8	695.6	662.7

2000 FT Pressure Altitude

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)										
	OAT (°C)										
	-40	14	18	22	26	30	34	38	42	46	50
4600	513.5	465.3	462.2	459.2	456.3	447.9	438.5	427.2	414.9	400.0	386.1
5000	538.2	488.0	484.8	481.7	478.6	469.9	460.1	448.3	435.5	420.0	405.5
5400	561.9	509.8	506.4	503.1	500.0	490.9	480.8	468.5	455.2	439.1	424.0
5800	584.7	530.7	527.3	523.9	520.6	511.2	500.7	488.0	474.2	457.5	442.0
6200	606.6	550.9	547.3	543.8	540.4	530.7	519.9	506.8	492.5	475.3	459.3
6600	627.7	570.4	566.7	563.1	559.6	549.6	538.4	524.9	510.3	492.5	476.0
7000	647.9	589.1	585.3	581.6	578.0	567.7	556.3	542.4	527.4	509.2	492.2
7400	667.2	606.9	603.1	599.3	595.6	585.1	573.4	559.2	543.8	525.2	507.8
7800	685.8	624.3	620.3	616.4	612.7	601.9	590.0	575.4	559.7	540.7	522.9
8200	704.7	641.8	637.8	633.8	630.0	619.0	606.8	592.0	575.9	556.5	538.4
8600	722.6	658.6	654.4	650.4	646.5	635.3	622.9	607.7	591.4	571.6	553.1
9000	738.7	673.4	669.2	665.1	661.1	649.7	637.0	621.6	604.9	584.7	565.9
9400	753.2	686.7	682.5	678.3	674.2	662.6	649.7	634.0	617.0	596.5	577.3
9800	767.6	699.9	695.6	691.3	687.2	675.4	662.2	646.2	629.0	608.0	588.5
10200	781.6	712.7	708.3	704.0	699.8	687.8	674.4	658.1	640.6	619.3	599.4
10600	795.2	725.2	720.7	716.3	712.1	699.9	686.2	669.7	651.9	630.2	610.1
11000	808.5	737.4	732.9	728.4	724.0	711.7	697.8	681.1	662.9	641.0	620.4
CLIMB LIMIT WT (1000 LB)	779.2	778.9	778.6	778.4	778.1	756.9	733.8	704.6	673.5	640.1	610.2

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 1100 lb and climb limit weight by 4200 lb.

With engine and wing anti-ice on, decrease field limit weight by 2100 lb and climb limit weight by 3900 lb.

Takeoff Field & Climb Limit Weights - Dry Runway**Flaps 15****4000 FT Pressure Altitude**

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)										
	OAT (°C)										
	-40	14	18	22	26	30	34	38	42	46	50
4600	479.2	434.6	431.7	428.8	422.4	414.1	403.9	393.0	380.3	367.0	355.3
5000	502.5	456.0	453.0	450.0	443.3	434.7	424.0	412.7	399.4	385.6	373.4
5400	524.8	476.4	473.3	470.2	463.3	454.4	443.2	431.5	417.7	403.3	390.7
5800	546.3	496.2	493.0	489.8	482.7	473.4	461.8	449.7	435.4	420.5	407.4
6200	567.0	515.3	512.0	508.7	501.3	491.7	479.8	467.3	452.5	437.2	423.6
6600	586.9	533.7	530.3	526.8	519.3	509.4	497.1	484.2	469.1	453.2	439.3
7000	606.1	551.4	547.9	544.4	536.6	526.5	513.9	500.6	485.1	468.8	454.5
7400	624.3	568.4	564.8	561.2	553.2	542.9	530.0	516.4	500.5	483.9	469.2
7800	642.1	584.9	581.2	577.5	569.4	558.8	545.6	531.8	515.5	498.5	483.5
8200	660.0	601.6	597.9	594.1	585.8	575.0	561.5	547.4	530.8	513.4	498.1
8600	677.1	617.6	613.7	609.9	601.4	590.4	576.7	562.3	545.3	527.6	512.1
9000	692.2	631.6	627.7	623.8	615.2	603.9	590.0	575.3	558.0	540.0	524.1
9400	706.0	644.2	640.2	636.3	627.5	616.0	601.8	586.9	569.3	550.9	534.8
9800	719.5	656.6	652.6	648.5	639.6	627.9	613.5	598.2	580.3	561.6	545.2
10200	732.6	668.7	664.6	660.5	651.4	639.5	624.8	609.3	591.1	572.1	555.3
10600	745.4	680.5	676.3	672.1	662.8	650.8	635.8	620.1	601.6	582.3	565.2
11000	758.0	692.0	687.7	683.5	674.1	661.8	646.6	630.6	611.8	592.2	574.9
CLIMB LIMIT WT (1000 LB)	726.9	726.6	726.4	726.1	714.1	696.2	673.1	648.6	619.1	589.4	564.4

6000 FT Pressure Altitude

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)										
	OAT (°C)										
	-40	14	18	22	26	30	34	38	42	46	50
4600	445.9	403.3	400.3	394.9	386.8	377.0	368.3	358.8	347.6	336.6	326.0
5000	467.8	423.3	420.3	414.6	406.2	396.0	386.9	377.1	365.3	353.9	342.8
5400	488.7	442.6	439.4	433.5	424.8	414.2	404.7	394.5	382.3	370.4	358.9
5800	509.0	461.2	457.9	451.8	442.8	431.8	422.0	411.4	398.8	386.5	374.6
6200	528.4	479.1	475.7	469.4	460.1	448.8	438.6	427.7	414.7	402.0	389.7
6600	547.2	496.4	492.9	486.4	476.9	465.2	454.8	443.5	430.1	417.0	404.4
7000	565.3	513.1	509.6	502.9	493.1	481.1	470.4	458.8	445.0	431.6	418.7
7400	582.6	529.2	525.6	518.7	508.7	496.4	485.5	473.7	459.5	445.8	432.5
7800	599.4	544.8	541.1	534.1	523.8	511.3	500.1	488.0	473.6	459.6	446.0
8200	616.4	560.7	556.9	549.8	539.3	526.5	515.1	502.8	488.0	473.7	459.9
8600	632.7	575.9	572.0	564.7	554.0	541.0	529.3	516.8	501.8	487.2	473.0
9000	647.0	589.1	585.2	577.8	566.9	553.6	541.7	528.9	513.6	498.7	484.3
9400	659.9	601.0	597.0	589.4	578.3	564.8	552.7	539.6	524.1	508.9	494.3
9800	672.6	612.6	608.5	600.8	589.5	575.7	563.4	550.2	534.3	518.9	504.0
10200	684.9	623.9	619.8	611.9	600.4	586.4	573.9	560.4	544.3	528.6	513.4
10600	697.0	635.0	630.7	622.8	611.1	596.8	584.1	570.4	554.0	538.1	522.6
11000	708.7	645.7	641.4	633.3	621.5	607.0	594.1	580.2	563.5	547.3	531.6
CLIMB LIMIT WT (1000 LB)	674.9	674.9	674.6	667.1	651.5	631.2	612.9	592.5	567.3	543.2	520.7

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 1100 lb and climb limit weight by 4200 lb.

With engine and wing anti-ice on, decrease field limit weight by 2100 lb and climb limit weight by 3900 lb.

Takeoff Field & Climb Limit Weights - Dry Runway

Flaps 15

8000 FT Pressure Altitude

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)										
	OAT (°C)										
	-40	14	18	22	26	30	34	38	42	46	50
4600	409.4	369.4	364.4	357.3	348.5	340.4	331.8	322.0	311.9	302.0	292.0
5000	429.8	388.0	382.9	375.5	366.3	357.8	348.9	338.7	328.1	317.8	307.4
5400	449.2	405.9	400.5	392.8	383.3	374.5	365.2	354.7	343.7	333.0	322.2
5800	468.1	423.2	417.6	409.7	399.8	390.7	381.1	370.1	358.8	347.7	336.5
6200	486.2	439.9	434.2	425.9	415.8	406.3	396.4	385.1	373.4	361.9	350.4
6600	503.7	456.0	450.2	441.7	431.2	421.5	411.3	399.7	387.6	375.8	363.9
7000	520.7	471.7	465.6	456.9	446.2	436.2	425.8	413.8	401.4	389.3	377.1
7400	536.9	486.8	480.6	471.7	460.7	450.5	439.8	427.6	414.9	402.5	390.0
7800	552.7	501.5	495.2	486.1	474.8	464.4	453.4	440.9	427.9	415.3	402.5
8200	568.8	516.5	510.0	500.7	489.3	478.6	467.5	454.7	441.4	428.5	415.5
8600	584.1	530.8	524.2	514.7	503.0	492.2	480.8	467.8	454.2	441.1	427.8
9000	597.5	543.2	536.5	526.8	514.9	503.8	492.2	479.0	465.2	451.8	438.3
9400	609.5	554.2	547.3	537.5	525.4	514.1	502.3	488.8	474.8	461.1	447.3
9800	621.3	564.9	558.0	548.0	535.6	524.2	512.2	498.4	484.1	470.2	456.2
10200	632.7	575.4	568.4	558.2	545.6	534.0	521.7	507.8	493.2	479.1	464.8
10600	643.9	585.7	578.5	568.1	555.3	543.5	531.1	516.9	502.1	487.7	473.2
11000	654.8	595.7	588.4	577.9	564.9	552.9	540.2	525.8	510.8	496.2	481.5
CLIMB LIMIT WT (1000 LB)	620.6	620.5	613.3	599.8	581.8	565.4	547.3	526.4	504.0	482.8	461.8

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 1100 lb and climb limit weight by 4200 lb.

With engine and wing anti-ice on, decrease field limit weight by 2100 lb and climb limit weight by 3900 lb.

Takeoff Field Corrections - Wet Runway
Slope Corrections

FIELD LENGTH AVAILABLE (FT)	SLOPE CORRECTED FIELD LENGTH (FT)								
	RUNWAY SLOPE (%)								
	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0
4200	4240	4230	4220	4210	4200	4150	4110	4060	4020
4600	4690	4670	4650	4620	4600	4540	4480	4420	4360
5000	5140	5100	5070	5030	5000	4930	4850	4780	4710
5400	5590	5540	5490	5450	5400	5310	5230	5140	5060
5800	6040	5980	5920	5860	5800	5700	5600	5500	5400
6200	6480	6410	6340	6270	6200	6090	5980	5860	5750
6600	6930	6850	6770	6680	6600	6470	6350	6220	6100
7000	7380	7290	7190	7100	7000	6860	6720	6580	6450
7400	7830	7720	7610	7510	7400	7250	7100	6940	6790
7800	8280	8160	8040	7920	7800	7640	7470	7310	7140
8200	8730	8600	8460	8330	8200	8020	7840	7670	7490
8600	9180	9030	8890	8740	8600	8410	8220	8030	7830
9000	9620	9470	9310	9160	9000	8800	8590	8390	8180
9400	10070	9900	9740	9570	9400	9180	8960	8750	8530
9800	10520	10340	10160	9980	9800	9570	9340	9110	8880
10200	10970	10780	10580	10390	10200	9960	9710	9470	9220
10600	11420	11210	11010	10800	10600	10340	10090	9830	9570
11000	11870	11650	11430	11220	11000	10730	10460	10190	9920
11400	12310	12090	11860	11630	11400	11120	10830	10550	10270
11800	12760	12520	12280	12040	11800	11500	11210	10910	10610

Wind Corrections

SLOPE CORR'D FIELD LENGTH (FT)	SLOPE & WIND CORRECTED FIELD LENGTH (FT)							
	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
4200	3050	3430	3820	4200	4470	4740	5040	5340
4600	3380	3790	4190	4600	4880	5170	5480	5800
5000	3720	4150	4570	5000	5290	5600	5920	6260
5400	4050	4500	4950	5400	5700	6020	6360	6720
5800	4390	4860	5330	5800	6110	6450	6800	7180
6200	4720	5220	5710	6200	6520	6870	7250	7640
6600	5060	5570	6090	6600	6940	7300	7690	8100
7000	5400	5930	6470	7000	7350	7730	8130	8560
7400	5730	6290	6840	7400	7760	8150	8570	9020
7800	6070	6640	7220	7800	8170	8580	9010	9480
8200	6400	7000	7600	8200	8580	9000	9450	9940
8600	6740	7360	7980	8600	9000	9430	9900	10400
9000	7070	7710	8360	9000	9410	9850	10340	10860
9400	7410	8070	8740	9400	9820	10280	10780	11320
9800	7740	8430	9110	9800	10230	10710	11220	11780
10200	8080	8790	9490	10200	10640	11130	11660	12240
10600	8410	9140	9870	10600	11060	11560	12110	12700
11000	8750	9500	10250	11000	11470	11980	12550	13160
11400	9080	9860	10630	11400	11880	12410	12990	13620
11800	9420	10210	11010	11800	12290	12830	13430	14080

Takeoff Field & Climb Limit Weights - Wet Runway**Flaps 15****Sea Level Pressure Altitude**

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)										
	OAT (°C)										
	-40	14	18	22	26	30	34	38	42	46	50
5900	626.2	563.5	559.7	555.9	552.2	548.6	537.1	523.2	507.8	492.1	476.6
6200	643.2	578.7	574.8	570.9	567.1	563.4	551.6	537.2	521.5	505.3	489.4
6600	664.8	598.0	593.9	589.9	586.0	582.2	569.9	555.1	538.8	522.1	505.6
7000	685.6	616.7	612.5	608.4	604.3	600.3	587.7	572.4	555.5	538.3	521.2
7400	705.5	634.5	630.1	625.9	621.7	617.6	604.6	588.8	571.5	553.7	536.1
7800	725.1	652.1	647.6	643.2	638.9	634.7	621.4	605.1	587.3	569.0	550.9
8200	745.6	670.6	666.0	661.5	657.1	652.8	639.0	622.4	604.0	585.3	566.7
8600	765.6	688.7	684.0	679.4	674.8	670.4	656.3	639.2	620.4	601.2	582.2
9000	783.6	704.8	700.0	695.3	690.7	686.1	671.7	654.2	634.9	615.2	595.7
9400	800.0	719.4	714.4	709.6	704.9	700.2	685.4	667.5	647.8	627.6	607.7
9800	816.2	733.8	728.7	723.8	718.9	714.1	699.1	680.7	660.6	639.9	619.5
10200	832.7	748.5	743.3	738.2	733.3	728.4	713.0	694.2	673.6	652.5	631.7
10600	834.9	763.2	757.9	752.8	747.7	742.7	727.0	707.8	686.8	665.3	644.0
11000	834.9	777.7	772.3	767.0	761.8	756.8	740.7	721.2	699.7	677.7	656.0
11400	834.9	791.7	786.2	780.9	775.6	770.4	754.1	734.2	712.3	689.9	667.7
11800	834.9	805.5	799.9	794.4	789.1	783.8	767.1	746.9	724.6	701.8	679.2
12200	834.9	818.8	813.1	807.5	802.1	796.7	779.7	759.1	736.5	713.3	690.3
12600	834.9	831.7	825.9	820.2	814.7	809.3	792.0	771.1	748.0	724.5	701.2
CLIMB LIMIT WT (1000 LB)	823.3	823.2	822.9	822.6	822.3	821.9	794.3	763.1	728.8	695.6	662.7

2000 FT Pressure Altitude

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)										
	OAT (°C)										
	-40	14	18	22	26	30	34	38	42	46	50
5900	583.5	527.5	524.0	520.4	517.0	507.2	496.3	483.2	469.1	453.9	439.7
6200	599.3	541.7	538.0	534.4	530.9	520.8	509.6	496.1	481.7	466.0	451.4
6600	619.4	559.8	555.9	552.2	548.5	538.1	526.5	512.5	497.6	481.3	466.3
7000	638.7	577.2	573.2	569.4	565.6	554.8	542.8	528.4	513.0	496.2	480.6
7400	657.2	593.8	589.7	585.7	581.9	570.7	558.4	543.6	527.6	510.4	494.3
7800	675.4	610.2	606.0	601.9	597.9	586.5	573.8	558.6	542.2	524.4	508.0
8200	694.5	627.6	623.3	619.1	615.0	603.3	590.2	574.5	557.7	539.5	522.6
8600	713.3	644.6	640.2	635.9	631.7	619.6	606.3	590.2	573.0	554.3	536.9
9000	730.0	659.7	655.2	650.7	646.4	634.1	620.4	603.9	586.3	567.1	549.3
9400	745.1	673.1	668.5	664.0	659.6	647.0	633.0	616.1	598.0	578.4	560.2
9800	760.1	686.5	681.7	677.1	672.6	659.7	645.4	628.1	609.7	589.6	571.0
10200	775.4	700.1	695.3	690.6	686.0	672.8	658.1	640.5	621.6	601.1	582.1
10600	790.7	713.9	708.9	704.1	699.4	685.9	671.0	653.0	633.7	612.8	593.3
11000	805.7	727.3	722.3	717.3	712.5	698.8	683.5	665.2	645.5	624.1	604.3
11400	820.3	740.4	735.3	730.3	725.4	711.4	695.8	677.1	657.0	635.3	615.1
11800	834.6	753.2	748.0	742.9	737.9	723.6	707.8	688.7	668.3	646.2	625.6
12200	834.9	765.6	760.3	755.1	750.0	735.5	719.4	700.0	679.3	656.7	635.8
12600	834.9	777.6	772.2	767.0	761.8	747.1	730.7	711.0	689.9	667.0	645.7
CLIMB LIMIT WT (1000 LB)	779.2	778.9	778.6	778.4	778.1	756.9	733.8	704.6	673.5	640.1	610.2

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 1100 lb and climb limit weight by 4200 lb.

With engine and wing anti-ice on, decrease field limit weight by 2400 lb and climb limit weight by 3900 lb.

Takeoff Field & Climb Limit Weights - Wet Runway**Flaps 15****4000 FT Pressure Altitude**

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)										
	OAT (°C)										
	-40	14	18	22	26	30	34	38	42	46	50
5900	543.5	491.5	488.2	484.9	477.5	468.0	457.2	446.1	433.0	419.3	407.4
6200	558.1	504.7	501.3	497.9	490.3	480.5	469.4	457.9	444.5	430.5	418.2
6600	576.7	521.4	517.9	514.3	506.5	496.4	484.9	473.0	459.1	444.6	431.9
7000	594.7	537.6	533.9	530.3	522.2	511.7	499.9	487.6	473.3	458.3	445.1
7400	611.8	553.0	549.2	545.5	537.2	526.4	514.1	501.5	486.7	471.3	457.8
7800	628.8	568.2	564.4	560.5	552.0	540.9	528.3	515.4	500.1	484.2	470.3
8200	646.7	584.5	580.5	576.6	567.8	556.4	543.5	530.2	514.5	498.2	483.9
8600	664.1	600.4	596.3	592.3	583.3	571.6	558.3	544.7	528.7	511.9	497.3
9000	679.7	614.4	610.2	606.1	596.8	584.9	571.3	557.3	540.9	523.8	508.7
9400	693.6	626.8	622.5	618.3	608.9	596.6	582.7	568.4	551.6	534.1	518.7
9800	707.4	639.1	634.7	630.4	620.7	608.2	594.0	579.3	562.2	544.2	528.5
10200	721.5	651.7	647.2	642.8	632.9	620.1	605.6	590.6	573.1	554.7	538.7
10600	735.7	664.4	659.8	655.3	645.2	632.1	617.3	602.0	584.1	565.4	549.0
11000	749.6	676.8	672.2	667.5	657.3	643.9	628.8	613.2	594.9	575.8	559.1
11400	763.2	689.0	684.2	679.5	669.0	655.4	640.0	624.1	605.5	586.0	569.9
11800	776.4	700.8	696.0	691.2	680.5	666.7	651.0	634.8	615.8	596.0	578.6
12200	789.2	712.3	707.4	702.5	691.7	677.6	661.6	645.2	625.9	605.7	588.0
12600	801.6	723.5	718.5	713.6	702.5	688.2	672.0	655.3	635.6	615.1	597.2
CLIMB LIMIT WT (1000 LB)	726.9	726.6	726.4	726.1	714.1	696.2	673.1	648.6	619.1	589.4	564.4

6000 FT Pressure Altitude

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)										
	OAT (°C)										
	-40	14	18	22	26	30	34	38	42	46	50
5900	504.6	456.3	453.2	447.5	439.2	429.1	420.1	410.4	398.8	387.5	376.6
6200	518.2	468.5	465.3	459.4	450.9	440.5	431.2	421.3	409.3	397.7	386.6
6600	535.4	484.0	480.7	474.6	465.7	455.0	445.4	435.1	422.7	410.7	399.2
7000	552.0	498.9	495.5	489.2	480.1	469.0	459.1	448.4	435.7	423.3	411.4
7400	567.9	513.2	509.7	503.2	493.8	482.4	472.1	461.2	448.0	435.3	423.0
7800	583.6	527.3	523.7	517.0	507.4	495.6	485.1	473.8	460.3	447.2	434.6
8200	600.2	542.4	538.7	531.9	522.0	509.9	499.1	487.5	473.7	460.2	447.2
8600	616.5	557.3	553.5	546.4	536.3	523.9	512.8	500.9	486.7	472.9	459.6
9000	630.9	570.2	566.3	559.1	548.7	536.0	524.7	512.5	497.9	483.8	470.1
9400	643.7	581.6	577.6	570.3	559.6	546.6	535.0	522.5	507.6	493.1	479.2
9800	656.4	592.8	588.8	581.2	570.4	557.1	545.2	532.4	517.2	502.4	488.1
10200	669.3	604.4	600.3	592.6	581.4	567.9	555.7	542.7	527.1	511.9	497.4
10600	682.4	616.1	611.9	604.0	592.6	578.8	566.4	553.1	537.2	521.7	506.8
11000	695.2	627.6	623.2	615.2	603.6	589.5	576.8	563.2	547.0	531.2	516.0
11400	707.7	638.8	634.4	626.2	614.4	600.0	587.0	573.2	556.7	540.6	525.1
11800	719.9	649.7	645.2	636.9	624.9	610.2	597.0	583.0	566.1	549.7	533.9
12200	731.8	660.3	655.8	647.3	635.1	620.1	606.8	592.4	575.3	558.6	542.6
12600	743.2	670.7	666.0	657.4	645.0	629.8	616.2	601.7	584.3	567.3	551.0
CLIMB LIMIT WT (1000 LB)	674.9	674.9	674.6	667.1	651.5	631.2	612.9	592.5	567.3	543.2	520.7

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 1100 lb and climb limit weight by 4200 lb.

With engine and wing anti-ice on, decrease field limit weight by 2400 lb and climb limit weight by 3900 lb.

Takeoff Field & Climb Limit Weights - Wet Runway

Flaps 15

8000 FT Pressure Altitude

CORR'D FIELD LENGTH (FT)	FIELD LIMIT WEIGHT (1000 LB)										
	OAT (°C)										
	-40	14	18	22	26	30	34	38	42	46	50
5900	465.5	420.9	415.7	408.4	399.3	390.9	382.1	372.0	361.6	351.7	341.9
6200	477.9	432.1	426.8	419.2	409.9	401.2	392.2	381.8	371.1	360.9	350.8
6600	493.7	446.2	440.7	432.9	423.3	414.3	404.9	394.2	383.2	372.6	362.1
7000	509.0	460.0	454.3	446.2	436.3	427.0	417.3	406.3	394.9	384.0	373.1
7400	523.5	473.0	467.2	458.9	448.6	439.1	429.1	417.7	406.0	394.8	383.6
7800	537.9	486.0	480.0	471.5	460.9	451.1	440.9	429.2	417.1	405.5	394.1
8200	553.4	500.1	493.9	485.1	474.3	464.2	453.7	441.7	429.3	417.4	405.6
8600	568.5	513.8	507.5	498.5	487.4	477.0	466.2	453.9	441.2	429.0	416.9
9000	581.7	525.7	519.2	510.0	498.6	488.0	477.0	464.3	451.3	438.8	426.5
9400	593.3	536.0	529.4	520.0	508.3	497.5	486.2	473.2	459.9	447.2	434.5
9800	604.9	546.2	539.5	529.8	517.9	506.8	495.2	482.0	468.4	455.3	442.4
10200	616.7	556.8	549.9	540.0	527.8	516.5	504.7	491.1	477.2	463.9	450.6
10600	628.7	567.5	560.4	550.3	537.9	526.3	514.2	500.4	486.2	472.6	459.0
11000	640.4	578.0	570.7	560.4	547.7	535.9	523.6	509.5	495.0	481.1	467.3
11400	651.8	588.2	580.8	570.3	557.4	545.4	532.8	518.5	503.7	489.5	475.4
11800	663.0	598.2	590.7	580.0	566.9	554.6	541.8	527.2	512.1	497.7	483.4
12200	673.8	608.0	600.3	589.5	576.1	563.6	550.6	535.7	520.4	505.8	491.2
12600	684.4	617.5	609.7	598.7	585.1	572.4	559.2	544.1	528.5	513.6	498.8
CLIMB LIMIT WT (1000 LB)	620.6	620.5	613.3	599.8	581.8	565.4	547.3	526.4	504.0	482.8	461.8

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.

With engine bleed for packs off, increase field limit weight by 1100 lb and climb limit weight by 4200 lb.

With engine and wing anti-ice on, decrease field limit weight by 2400 lb and climb limit weight by 3900 lb.

Takeoff Obstacle Limit Weight**Flaps 15**

Sea Level, 30°C & Below, Zero Wind

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

OBSTACLE HEIGHT (FT)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 LB)								
	DISTANCE FROM BRAKE RELEASE (1000 FT)								
	8	10	12	14	16	18	20	22	24
10	651.6	721.7	784.7	831.0					
50	621.4	687.0	741.4	787.8	822.7				
100	588.2	653.4	703.9	746.2	782.2	809.6	830.3		
150	560.4	625.1	674.3	714.9	749.2	778.7	801.4	820.0	834.1
200	536.5	599.6	649.3	689.2	722.7	751.2	776.1	795.5	811.8
250	515.5	576.9	627.2	666.9	700.1	728.3	752.5	773.9	791.0
300	496.6	556.6	606.7	647.0	680.0	708.1	732.4	753.4	772.0
350	479.5	538.5	587.9	628.7	661.8	690.0	714.2	735.4	753.9
400	463.8	522.0	570.6	611.5	645.1	673.3	697.7	718.9	737.7
450	449.3	506.7	554.7	595.4	629.5	657.9	682.4	703.8	722.6
500	436.3	492.6	540.0	580.3	614.7	643.5	668.1	689.7	708.7
550	424.2	479.4	526.3	566.3	600.6	629.9	654.7	676.4	695.6
600	412.6	467.1	513.5	553.1	587.3	616.9	642.0	663.9	683.3
650	401.9	455.5	501.4	540.7	574.8	604.4	629.9	652.0	671.5
700	391.7	444.6	489.9	529.0	562.9	592.5	618.4	640.7	660.3
750	381.9	434.5	479.1	517.9	551.6	581.2	607.1	629.8	649.7
800	372.6	424.9	468.9	507.4	540.9	570.4	596.4	619.3	639.4
850		415.6	459.1	497.3	530.6	560.0	586.1	609.2	629.5
900		406.8	449.9	487.7	520.9	550.2	576.2	599.3	620.0
950		398.4	441.1	478.5	511.6	540.7	566.7	589.9	610.7
1000		390.3	432.8	469.8	502.6	531.7	557.6	580.8	601.6

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustments

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 LB)						
	360	440	520	600	680	760	840
30 & Below	0	0	0	0	0	0	0
32	-6.2	-7.6	-9.0	-10.4	-11.7	-13.1	-14.5
34	-12.4	-15.1	-17.9	-20.7	-23.5	-26.3	-29.0
36	-18.6	-22.7	-26.9	-31.1	-35.2	-39.4	-43.6
38	-24.7	-30.3	-35.9	-41.4	-47.0	-52.5	-58.1
40	-30.9	-37.9	-44.8	-51.8	-58.7	-65.6	-72.6
42	-38.6	-46.9	-55.3	-63.7	-72.1	-80.5	-88.9
44	-46.2	-56.0	-65.8	-75.7	-85.5	-95.3	-105.2
46	-53.8	-65.1	-76.4	-87.6	-98.9	-110.2	-121.5
48	-61.4	-74.2	-86.9	-99.6	-112.3	-125.0	-137.8
50	-69.1	-83.2	-97.4	-111.6	-125.7	-139.9	-154.0

Takeoff Obstacle Limit Weight

Flaps 15

Pressure Altitude Adjustments

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 LB)						
	360	440	520	600	680	760	840
S.L. & Below	0	0	0	0	0	0	0
1000	-15.5	-18.4	-21.3	-24.1	-27.0	-29.9	-32.7
2000	-31.1	-36.8	-42.5	-48.3	-54.0	-59.7	-65.4
3000	-45.4	-53.8	-62.2	-70.5	-78.9	-87.3	-95.7
4000	-59.7	-70.7	-81.8	-92.8	-103.8	-114.9	-125.9
5000	-75.1	-89.0	-102.9	-116.8	-130.7	-144.6	-158.5
6000	-90.6	-107.3	-124.1	-140.8	-157.5	-174.3	-191.0
7000	-105.3	-125.1	-144.8	-164.6	-184.4	-204.1	-223.9
8000	-120.0	-142.8	-165.6	-188.4	-211.2	-234.0	-256.8

Wind Adjustments

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 LB)						
	360	440	520	600	680	760	840
15 TW	-79.5	-80.5	-81.6	-82.6	-83.7	-84.7	-85.7
10 TW	-53.0	-53.7	-54.4	-55.1	-55.8	-56.5	-57.2
5 TW	-26.5	-26.8	-27.2	-27.5	-27.9	-28.2	-28.6
0	0	0	0	0	0	0	0
10 HW	8.8	8.4	8.0	7.6	7.2	6.7	6.3
20 HW	17.7	16.8	16.0	15.1	14.3	13.5	12.6
30 HW	27.8	26.4	25.0	23.5	22.1	20.7	19.3
40 HW	37.9	35.9	33.9	31.9	29.9	27.9	25.9

With engine bleed for packs off, increase weight by 1900 lb.

With engine and wing anti-ice on, decrease weight by 4400 lb.

**Tire Speed Limit
Flaps 15**

AIRPORT OAT		TIRE SPEED LIMIT WEIGHT (1000 LB)				
		AIRPORT PRESSURE ALTITUDE (FT)				
(°C)	(°F)	0	2000	4000	6000	8000
54	129	810.2	746.0	689.8	638.7	591.1
52	126	814.6	750.5	693.7	642.4	594.5
50	122	818.9	754.9	697.6	646.0	597.9
48	118	823.5	761.0	701.7	649.8	601.4
46	115	828.0	767.0	705.7	653.6	604.9
44	111	831.2	772.7	709.8	657.3	608.4
42	108	833.1	777.8	713.9	661.2	612.1
40	104	834.9	783.0	718.0	665.0	615.7
38	100	835.0	787.5	722.6	669.0	619.4
36	97	835.0	792.1	727.2	673.0	623.2
34	93	835.0	796.7	731.8	677.2	627.1
32	90	835.0	801.5	736.8	681.4	631.0
30	86	835.0	806.5	741.6	685.8	635.1
28	82	835.0	811.6	746.7	690.2	639.2
26	79	835.0	816.7	752.0	694.7	643.5
24	75	835.0	822.5	757.5	699.2	647.8
22	72	835.0	828.3	764.0	704.1	652.0
20	68	835.0	834.0	774.2	709.1	656.4
18	64	835.0	835.0	780.2	714.2	661.0
16	61	835.0	835.0	785.9	719.6	665.7
14	57	835.0	835.0	791.6	725.4	670.5
12	54	835.0	835.0	797.4	731.2	675.6
10	50	835.0	835.0	803.2	737.1	680.7
-40	-40	835.0	835.0	835.0	835.0	835.0

Increase tire speed limit weight by 5600 lb per knot headwind.
Decrease tire speed limit weight by 11900 lb per knot tailwind.

Takeoff Speeds - Dry Runway

Flaps 15

V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 LB)	KIAS		
	V1	VR	V2
840	175	185	190
800	171	179	186
760	166	175	182
720	162	170	178
680	157	164	174
640	152	159	169
600	146	153	165
560	140	146	160
520	133	140	155
480	125	133	150
440	117	126	145
400	108	119	139
360	98	111	132

Check V1(MCG), Minimum VR.

V1, VR, V2 Adjustments*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
°C	°F	-2	0	2	4	6	8	-2	0	2	4	6	8	-2	0	2	4	6	8
70	158	12	14					7	8					-4	-4				
60	140	8	10	12	14			4	6	7	8			-3	-3	-4	-4		
50	122	5	6	8	10	13	16	3	4	5	6	8	9	-2	-2	-3	-3	-4	-5
40	104	1	3	5	7	10	13	1	2	3	5	6	8	-1	-1	-2	-2	-3	-4
30	86	0	0	2	5	8	11	0	0	2	3	5	7	0	0	-1	-2	-2	-3
20	68	0	0	2	4	6	9	0	0	1	2	4	6	0	0	-1	-1	-2	-3
-60	-76	0	0	2	4	6	8	0	0	1	2	4	5	0	0	-1	-1	-2	-2

Slope and Wind V1 Adjustments*

WEIGHT (1000 LB)	SLOPE (%)						WIND (KTS)							
	-2	-1	0	1	2		-15	-10	-5	0	10	20	30	40
840	-4	-1	0	3	6		-3	-1	0	0	1	3	4	5
800	-4	-1	0	3	5		-2	-1	0	0	1	3	3	4
760	-3	-1	0	3	4		-2	-1	0	0	1	2	3	4
720	-3	-1	0	2	4		-2	-1	0	0	1	2	3	3
680	-3	-1	0	2	4		-2	-1	0	0	1	2	2	3
640	-2	-1	0	2	4		-2	-1	0	0	1	2	2	3
600	-2	-1	0	2	3		-2	-1	0	0	1	2	2	3
560	-2	0	0	2	3		-2	-1	0	0	1	2	2	3
520	-2	0	0	2	3		-1	-1	0	0	1	2	3	3
480	-1	0	0	2	3		-1	-1	0	0	1	2	3	3
440	-1	0	0	3	4		-1	0	0	0	1	2	3	4
400	-1	0	0	3	4		-1	0	1	0	1	3	3	4
360	-1	0	0	3	4		-1	0	1	0	2	3	4	5

*V1 not to exceed VR

Takeoff Speeds - Dry Runway

Flaps 15

V1(MCG), Minimum VR

Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		-2000		0		2000		4000		6000		8000	
°C	°F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	116	118	113	115	111	113	109	111				
50	122	119	121	116	118	111	113	109	111	106	109	103	106
40	104	126	127	123	124	118	120	113	115	108	111	103	106
30	86	128	130	128	130	123	125	118	120	112	115	106	109
20	68	129	130	129	130	125	126	120	122	116	118	110	113
-60	-76	130	130	130	130	126	126	121	122	117	118	112	114

Takeoff Speeds - Wet Runway**Flaps 15****V1, VR, V2 for Max Takeoff Thrust**

WEIGHT (1000 LB)	KIAS		
	V1	VR	V2
840	169	185	190
800	164	179	186
760	158	175	182
720	153	170	178
680	147	164	174
640	141	159	169
600	134	153	165
560	128	146	160
520	121	140	155
480	113	133	150
440	105	126	145
400	97	119	139
360	89	111	132

Check V1(MCG), Minimum VR.

V1, VR, V2 Adjustments*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
°C	°F	-2	0	2	4	6	8	-2	0	2	4	6	8	-2	0	2	4	6	8
70	158	14	16					7	8					-4	-4				
60	140	10	11	14	16			4	6	7	8			-3	-3	-4	-4		
50	122	5	7	9	12	14	17	3	4	5	6	8	9	-2	-2	-3	-3	-4	-5
40	104	2	3	6	8	11	14	1	2	3	5	6	8	-1	-1	-2	-2	-3	-4
30	86	0	0	3	5	8	12	0	0	2	3	5	7	0	0	-1	-2	-2	-3
20	68	0	0	2	4	7	10	0	0	1	2	4	6	0	0	-1	-1	-2	-3
-60	-76	0	0	2	4	6	9	0	0	1	2	4	5	0	0	-1	-1	-2	-2

Slope and Wind V1 Adjustments*

WEIGHT (1000 LB)	SLOPE (%)						WIND (KTS)							
	-2	-1	0	1	2		-15	-10	-5	0	10	20	30	40
840	-6	-3	0	3	6		-3	-2	-1	0	1	2	3	4
800	-6	-3	0	3	6		-4	-3	-1	0	1	2	3	4
760	-6	-3	0	3	5		-4	-3	-1	0	1	2	3	4
720	-5	-3	0	3	5		-4	-3	-2	0	1	2	3	4
680	-5	-3	0	2	5		-5	-3	-2	0	1	2	3	4
640	-5	-2	0	2	5		-5	-3	-2	0	1	2	3	4
600	-5	-2	0	2	5		-5	-3	-1	0	1	2	3	4
560	-4	-2	0	2	4		-5	-3	-1	0	1	2	3	4
520	-4	-2	0	3	4		-5	-3	-1	0	1	3	4	5
480	-3	-1	0	3	4		-5	-3	-1	0	1	3	4	5
440	-2	-1	0	3	5		-4	-2	-1	0	2	3	4	5
400	-2	0	0	3	5		-4	-2	0	0	2	4	5	6
360	-1	1	0	4	5		-4	-2	0	0	2	4	5	7

*V1 not to exceed VR

Takeoff Speeds - Wet Runway
Flaps 15
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		-2000		0		2000		4000		6000		8000	
°C	°F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	116	118	113	115	111	113	109	111				
50	122	119	121	116	118	111	113	109	111	106	109	103	106
40	104	126	127	123	124	118	120	113	115	108	111	103	106
30	86	128	130	128	130	123	125	118	120	112	115	106	109
20	68	129	130	129	130	125	126	120	122	116	118	110	113
-60	-76	130	130	130	130	126	126	121	122	117	118	112	114

Intentionally
Blank

Performance Dispatch**Chapter PD****Enroute****Section 61****Long Range Cruise Maximum Operating Altitude****Max Climb Thrust****ISA + 10°C and Below**

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
780	28300	3	30800	29100	27600
760	28800	2	31300	29700	28200
740	29400	0	31800	30200	28700
720	30000	-1	32300	30700	29100
700	30700	-2	32800	31100	29600
680	31300	-4	33200	31600	30100
660	31900	-5	33700	32100	30600
640	32600	-7	34300	32700	31200
620	33300	-8	34800	33200	31700
600	34000	-10	35300	33800	32300
580	34700	-11	35900	34300	32900
560	35400	-13	36500	34900	33500
540	36200	-15	37100	35600	34100
520	37000	-15	37800	36200	34800
500	37800	-15	38400	36900	35500
480	38600	-15	39100	37600	36200
460	39500	-15	39900	38300	37000
440	40400	-15	40600	39100	37700
420	41400	-15	41400	39900	38600
400	42400	-15	42300	40800	39500
380	43100	-15	43100	41800	40500

ISA + 15°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
780	28300	9	30800	29100	27600
760	28800	8	31300	29700	28200
740	29400	6	31800	30200	28700
720	30000	5	32300	30700	29100
700	30700	3	32800	31100	29600
680	31300	2	33200	31600	30100
660	31900	1	33700	32100	30600
640	32600	-1	34300	32700	31200
620	33300	-2	34800	33200	31700
600	34000	-4	35300	33800	32300
580	34700	-6	35900	34300	32900
560	35400	-7	36500	34900	33500
540	36200	-9	37100	35600	34100
520	37000	-9	37800	36200	34800
500	37800	-9	38400	36900	35500
480	38600	-9	39100	37600	36200
460	39500	-9	39900	38300	37000
440	40400	-9	40600	39100	37700
420	41400	-9	41400	39900	38600
400	42400	-9	42300	40800	39500
380	43100	-9	43100	41800	40500

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
780	28300	15	30800	29100	27600
760	28800	13	31300	29700	28200
740	29400	12	31800	30200	28700
720	30000	11	32300	30700	29100
700	30700	9	32800	31100	29600
680	31300	8	33200	31600	30100
660	31900	6	33700	32100	30600
640	32600	5	34300	32700	31200
620	33300	3	34800	33200	31700
600	34000	2	35300	33800	32300
580	34700	0	35900	34300	32900
560	35400	-2	36500	34900	33500
540	36200	-3	37100	35600	34100
520	37000	-3	37800	36200	34800
500	37800	-3	38400	36900	35500
480	38600	-3	39100	37600	36200
460	39500	-3	39900	38300	37000
440	40400	-3	40600	39100	37700
420	41400	-3	41400	39900	38600
400	42400	-3	42300	40800	39500
380	43100	-3	43100	41800	40500

Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1058	994	937	886	841	800	766	735	706	679	655
1580	1487	1403	1328	1261	1200	1150	1104	1061	1021	985
2101	1979	1868	1769	1681	1600	1534	1473	1416	1364	1316
2620	2469	2332	2210	2100	2000	1918	1842	1771	1706	1647
3138	2959	2795	2650	2520	2400	2302	2211	2127	2049	1978
3654	3447	3258	3090	2939	2800	2687	2581	2483	2392	2309
4168	3933	3719	3529	3358	3200	3071	2950	2838	2735	2641
4679	4418	4180	3968	3776	3600	3455	3320	3194	3078	2972
5190	4903	4640	4406	4194	4000	3839	3689	3550	3421	3303
5699	5386	5099	4844	4612	4400	4224	4059	3906	3764	3635
6207	5868	5558	5281	5030	4800	4608	4429	4262	4108	3966
6713	6348	6015	5717	5448	5200	4992	4798	4618	4451	4298
7217	6828	6472	6153	5865	5600	5376	5168	4973	4794	4629
7721	7307	6928	6590	6283	6000	5761	5537	5329	5137	4960
8224	7786	7385	7026	6700	6400	6145	5906	5685	5480	5292
8726	8264	7841	7461	7117	6800	6529	6276	6040	5823	5623
9228	8742	8296	7897	7534	7200	6913	6645	6396	6166	5955
9728	9219	8751	8332	7951	7600	7297	7015	6752	6509	6286
10228	9695	9206	8767	8368	8000	7681	7384	7107	6852	6617

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	27		29		31		33		35	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
800	29.5	2:01	29.0	1:59	28.6	1:56	28.2	1:53	27.7	1:52
1200	43.1	2:57	42.1	2:53	41.4	2:49	40.7	2:45	39.9	2:42
1600	56.8	3:52	55.5	3:47	54.4	3:41	53.3	3:35	52.2	3:32
2000	70.5	4:47	68.8	4:41	67.4	4:33	66.0	4:26	64.5	4:22
2400	84.8	5:41	82.8	5:33	80.9	5:23	79.2	5:16	77.3	5:12
2800	99.1	6:34	96.7	6:25	94.5	6:14	92.3	6:06	90.1	6:02
3200	113.7	7:27	110.9	7:16	108.3	7:04	105.8	6:56	103.2	6:51
3600	128.6	8:19	125.5	8:07	122.4	7:54	119.5	7:45	116.5	7:41
4000	143.6	9:11	140.0	8:58	136.6	8:44	133.2	8:35	129.9	8:31
4400	159.2	10:02	155.1	9:47	151.2	9:33	147.4	9:24	144.0	9:20
4800	174.8	10:53	170.3	10:37	165.9	10:23	161.7	10:13	158.2	10:10
5200	190.8	11:43	185.7	11:26	180.9	11:12	176.3	11:02	172.8	11:00
5600	207.1	12:33	201.5	12:15	196.1	12:01	191.3	11:52	188.1	11:50
6000	223.4	13:22	217.2	13:04	211.4	12:49	206.2	12:41	203.3	12:39
6400	240.3	14:11	233.6	13:53	227.3	13:38	222.2	13:30	220.0	13:29
6800	257.3	15:00	250.0	14:42	243.2	14:27	238.2	14:20	236.6	14:19
7200	274.6	15:48	266.7	15:30	259.6	15:16	254.8	15:09	254.3	15:09
7600	292.3	16:37	283.8	16:19	276.5	16:05	272.1	15:58	273.0	15:59
8000	309.9	17:25	300.9	17:07	293.3	16:54	289.5	16:48	291.8	16:49

Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	LANDING WEIGHT (1000 LB)					
	350	400	450	500	550	600
20	-2.2	-1.1	0.0	1.5	2.8	4.6
40	-4.6	-2.3	0.0	2.6	5.6	10.0
60	-7.1	-3.6	0.0	3.9	9.0	16.5
80	-9.5	-4.9	0.0	5.4	13.1	24.0
100	-12.0	-6.2	0.0	7.4	17.8	32.7
120	-14.5	-7.5	0.0	9.6	23.1	42.4
140	-17.0	-8.8	0.0	12.2	29.2	53.2
160	-19.6	-10.1	0.0	15.1	35.8	65.1
180	-22.2	-11.4	0.0	18.3	43.2	78.1
200	-24.8	-12.7	0.0	21.8	51.1	92.2
220	-27.4	-14.0	0.0	25.7	59.8	107.3
240	-30.0	-15.3	0.0	29.8	69.0	123.6
260	-32.7	-16.6	0.0	34.3	79.0	140.9
280	-35.3	-17.9	0.0	39.1	89.6	159.3
300	-38.0	-19.3	0.0	44.2	100.8	178.8
320	-40.7	-20.6	0.0	49.7	112.7	199.3
340	-43.5	-21.9	0.0	55.4	125.2	221.0
360	-46.2	-23.2	0.0	61.4	138.4	243.7

Based on 310/.84 climb, Long Range Cruise and .84/310/250 descent.

Long Range Cruise Step Climb
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1040	981	928	881	839	800	765	732	703	675	650
1545	1461	1386	1318	1256	1200	1149	1102	1058	1018	981
2050	1941	1843	1754	1673	1600	1533	1471	1414	1361	1312
2555	2421	2300	2190	2091	2000	1917	1840	1769	1704	1643
3060	2900	2757	2626	2508	2400	2301	2209	2125	2047	1974
3564	3380	3213	3063	2925	2800	2685	2579	2481	2390	2306
4068	3859	3670	3499	3343	3200	3069	2948	2837	2733	2637
4572	4338	4127	3935	3760	3600	3453	3318	3193	3077	2969
5076	4817	4583	4371	4177	4000	3837	3687	3549	3420	3300
5580	5296	5039	4807	4594	4400	4221	4057	3905	3763	3632
6083	5775	5496	5242	5011	4800	4606	4426	4261	4107	3964
6587	6253	5952	5678	5429	5200	4990	4796	4617	4450	4296
7090	6732	6408	6114	5846	5600	5374	5166	4973	4794	4628
7593	7210	6864	6550	6263	6000	5758	5536	5329	5138	4960
8095	7688	7320	6985	6680	6400	6143	5905	5686	5482	5292
8598	8166	7776	7421	7097	6800	6527	6275	6042	5826	5624
9100	8644	8231	7856	7514	7200	6911	6645	6398	6169	5956
9602	9122	8687	8292	7931	7600	7296	7015	6755	6513	6289
10104	9599	9142	8727	8348	8000	7680	7385	7111	6858	6621

Trip Fuel and Time Required

AIR DIST (NM)	TRIP FUEL (1000 LB)											TIME (HRS:MIN)
	LANDING WEIGHT (1000 LB)											
	360	380	400	420	440	460	480	500	520	540	560	
800	23.3	24.0	24.9	25.7	26.8	27.7	28.5	29.3	30.2	31.4	32.3	1:50
1200	33.0	34.1	35.3	36.7	38.4	39.6	40.7	42.0	43.6	45.3	46.5	2:40
1600	42.9	44.4	46.0	48.0	50.1	51.7	53.3	55.1	57.3	59.4	61.0	3:30
2000	53.0	54.9	57.0	59.6	62.1	64.1	66.1	68.6	71.3	73.8	75.8	4:20
2400	63.3	65.6	68.3	71.4	74.3	76.7	79.3	82.4	85.5	88.4	90.8	5:10
2800	73.7	76.6	79.9	83.4	86.7	89.6	92.9	96.5	100.0	103.3	106.3	5:59
3200	84.4	87.9	91.7	95.6	99.3	102.9	106.8	110.8	114.7	118.6	122.1	6:49
3600	95.3	99.5	103.7	108.0	112.4	116.6	121.0	125.3	129.8	134.3	138.4	7:38
4000	106.6	111.2	115.9	120.7	125.7	130.6	135.4	140.2	145.2	150.4	155.1	8:28
4400	118.2	123.2	128.4	133.7	139.5	144.8	150.0	155.4	161.1	166.8	172.1	9:17
4800	129.9	135.4	141.1	147.2	153.5	159.3	165.0	171.0	177.3	183.6	189.3	10:07
5200	141.9	147.9	154.1	161.0	167.8	174.0	180.3	187.0	193.9	200.7	206.9	10:56
5600	154.1	160.6	167.6	175.0	182.3	189.0	196.0	203.4	210.9	218.2	224.9	11:45
6000	166.5	173.6	181.4	189.3	197.1	204.4	212.1	220.1	228.1	236.0	243.4	12:34
6400	179.1	187.0	195.4	203.9	212.2	220.3	228.6	237.2	245.7	254.1	262.3	13:23
6800	192.1	200.8	209.7	218.7	227.7	236.5	245.5	254.5	263.6	272.9	281.6	14:12
7200	205.5	214.9	224.3	233.8	243.6	253.1	262.6	272.3	282.1	291.9	301.3	15:01
7600	219.3	229.2	239.1	249.4	259.9	270.1	280.1	290.4	300.9	311.4	321.4	15:50
8000	233.3	243.7	254.3	265.4	276.6	287.3	298.0	308.9	320.1	331.4	342.0	16:39

Based on 310/.84 climb, LRC and .84/310/250 descent.

Valid for all pressure altitudes with 4000 ft step climb to 2000 ft above optimum altitude.

Short Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
96	81	70	62	55	50	46	42	39	36	34
160	143	129	118	108	100	93	87	82	77	73
224	204	187	173	161	150	141	133	125	119	113
287	264	244	227	213	200	189	178	169	161	154
348	323	301	282	265	250	237	225	214	204	195
410	382	357	336	317	300	285	271	259	247	237
471	440	414	390	369	350	333	317	303	290	279
533	499	470	444	421	400	381	364	348	334	320
595	559	527	499	473	450	429	410	393	376	362
660	620	585	554	525	500	477	456	437	419	403

Trip Fuel and Time Required

AIR DISTANCE (NM)		LANDING WEIGHT (1000 LB)						TIME (HRS:MIN)
		360	400	440	480	520	560	
50	FUEL (1000 LB)	3.7	3.9	4.2	4.4	4.6	4.8	0:14
	ALT (FT)	11000	11000	9000	7000	7000	5000	
100	FUEL (1000 LB)	5.5	5.8	6.1	6.4	6.7	7.0	0:22
	ALT (FT)	15000	15000	13000	13000	13000	13000	
150	FUEL (1000 LB)	7.2	7.6	8.0	8.4	8.7	9.2	0:30
	ALT (FT)	23000	23000	23000	21000	21000	21000	
200	FUEL (1000 LB)	8.7	9.2	9.6	10.1	10.6	11.1	0:36
	ALT (FT)	29000	27000	27000	27000	25000	25000	
250	FUEL (1000 LB)	10.1	10.7	11.2	11.8	12.4	13.0	0:42
	ALT (FT)	37000	31000	29000	29000	27000	29000	
300	FUEL (1000 LB)	11.3	12.0	12.7	13.4	14.1	14.8	0:48
	ALT (FT)	43000	39000	37000	37000	35000	33000	
350	FUEL (1000 LB)	12.4	13.3	14.1	14.9	15.7	16.5	0:54
	ALT (FT)	43000	41000	39000	37000	35000	35000	
400	FUEL (1000 LB)	13.6	14.5	15.5	16.4	17.3	18.2	0:59
	ALT (FT)	43000	41000	39000	37000	35000	35000	
450	FUEL (1000 LB)	14.8	15.8	16.8	17.9	18.9	19.9	1:06
	ALT (FT)	43000	41000	39000	37000	37000	35000	
500	FUEL (1000 LB)	15.9	17.1	18.2	19.4	20.5	21.6	1:13
	ALT (FT)	43000	41000	39000	37000	37000	35000	

Holding Planning**Flaps Up**

WEIGHT (1000 LB)	TOTAL FUEL FLOW (LB/HR)										
	PRESSURE ALTITUDE (FT)										
	1500	5000	10000	15000	20000	25000	30000	35000	40000	43000	
800	21080	20850	20650	21390	22070	22890	24000				
760	20030	19830	19600	19980	20850	21520	22350				
720	18980	18810	18560	18680	19660	20140	20800				
680	17950	17770	17530	17480	18410	18820	19430				
640	16940	16740	16500	16420	16950	17570	18140				
600	15950	15730	15480	15370	15600	16380	16850	17580			
560	15000	14750	14460	14330	14360	15200	15560	16040			
520	14110	13820	13480	13320	13300	13760	14300	14730			
480	13280	12940	12550	12370	12310	12420	13070	13450			
440	12470	12110	11680	11500	11370	11330	11850	12180	12870		
400	11690	11320	10870	10680	10490	10400	10460	10970	11530		
360	11180	10800	10350	10110	9880	9730	9680	9810	10230	10550	

Flaps 1

WEIGHT (1000 LB)	TOTAL FUEL FLOW (LB/HR)					
	PRESSURE ALTITUDE (FT)					
	1500	5000	10000	15000	20000	
800	23060	23000	22910	23120	23640	
760	21780	21670	21550	21670	22160	
720	20580	20460	20320	20370	20800	
680	19410	19270	19110	19130	19490	
640	18250	18110	17920	17930	18180	
600	17120	16950	16730	16710	16860	
560	16020	15810	15570	15530	15610	
520	14970	14700	14440	14360	14400	
480	13970	13660	13340	13220	13210	
440	13010	12650	12290	12110	12060	
400	12100	11710	11300	11080	10970	
360	11450	11070	10600	10350	10210	

These tables include 5% additional fuel for holding in a racetrack pattern.

Crew Oxygen Requirements**Required Pressure (PSI) for One 114/115 Cubic Ft. Cylinder**

BOTTLE TEMPERATURE		NUMBER OF CREW USING OXYGEN			
°C	°F	2	3	4	
50	122	530	735	945	
45	113	520	725	930	
40	104	510	715	915	
35	95	505	700	900	
30	86	495	690	885	
25	77	485	680	870	
20	68	480	670	860	
15	59	470	655	840	
10	50	460	645	830	
5	41	455	635	815	
0	32	445	620	800	
-5	23	440	610	785	
-10	14	430	600	770	

For more extensive than normal crew usage, add 1.2 psi/person/minute.

ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 LB)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
30	399.4	395.0	382.9
28	430.8	421.2	405.7
26	464.5	451.9	435.2
24	500.6	484.9	467.6
22	538.7	521.7	503.0
20	592.3	577.6	555.9
18	641.7	622.3	598.3
16	695.5	671.7	645.7
14	743.0	715.0	686.1
12	790.9	760.6	730.9
10	833.2	801.9	768.0

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 LB)								
	PRESSURE ALTITUDE (1000 FT)								
	14	16	18	20	22	24	26	28	30
ENGINE ONLY	-1.4	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINE AND WING	-5.6	-3.9	-3.2	-2.2	-2.5	-2.6	-2.6	-2.7	-2.6

ALL ENGINES**Decompression Critical Fuel Reserves - LRC Cruise
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEAD WIND COMPONENT (KTS)						TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
282	261	242	226	212	200	189	179	170	162	155
565	522	485	453	425	400	378	358	340	324	310
847	783	727	679	637	600	567	537	511	486	464
1130	1044	970	906	850	800	756	716	681	649	619
1412	1304	1212	1132	1062	1000	945	895	851	811	774
1694	1565	1455	1359	1274	1200	1134	1075	1021	973	929
1977	1826	1697	1585	1487	1400	1323	1254	1191	1135	1084
2259	2087	1939	1811	1699	1600	1512	1433	1362	1297	1239
2541	2348	2182	2038	1912	1800	1701	1612	1532	1459	1393
2824	2609	2424	2264	2124	2000	1890	1791	1702	1622	1548
3106	2870	2667	2491	2336	2200	2079	1970	1872	1784	1703
3389	3131	2909	2717	2549	2400	2268	2149	2042	1946	1858
3671	3392	3152	2943	2761	2600	2457	2328	2213	2108	2013
3953	3652	3394	3170	2973	2800	2646	2507	2383	2270	2168
4236	3913	3637	3396	3186	3000	2835	2687	2553	2432	2322

Critical Fuel (1000 LB)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 LB)										
	380	420	460	500	540	580	620	660	700	740	780
200	9.7	10.1	10.4	10.8	11.2	11.6	12.1	12.5	12.9	13.3	13.8
400	17.8	18.4	19.1	19.8	20.5	21.2	21.9	22.6	23.3	24.0	24.8
600	25.8	26.7	27.6	28.6	29.6	30.6	31.6	32.5	33.5	34.5	35.6
800	33.5	34.7	36.0	37.3	38.6	39.9	41.2	42.4	43.6	45.0	46.3
1000	41.3	42.8	44.3	45.9	47.5	49.1	50.8	52.3	53.8	55.4	57.1
1200	49.1	50.9	52.7	54.6	56.5	58.4	60.3	62.2	63.9	65.8	67.8
1400	56.8	58.9	61.0	63.2	65.4	67.6	69.8	71.8	73.8	75.9	78.2
1600	64.6	66.9	69.2	71.6	74.1	76.6	79.0	81.4	83.7	86.1	88.6
1800	72.0	74.6	77.3	80.0	82.7	85.5	88.3	91.0	93.6	96.2	99.0
2000	79.5	82.4	85.3	88.3	91.4	94.5	97.6	100.6	103.4	106.3	109.3
2200	87.0	90.2	93.4	96.7	100.0	103.4	106.8	110.0	113.1	116.2	119.5
2400	94.5	97.9	101.5	105.0	108.5	112.1	115.7	119.3	122.7	126.1	129.6
2600	102.0	105.6	109.3	113.1	116.9	120.8	124.7	128.5	132.2	135.9	139.8
2800	109.4	113.1	117.1	121.1	125.2	129.4	133.7	137.8	141.8	145.8	149.8
3000	116.9	120.6	124.8	129.2	133.6	138.1	142.6	147.0	151.2	155.4	159.7

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included.

Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required 0.7% per 10°C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (3%) for the total forecast time or engine and wing anti-ice on and ice drag (8%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engine cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

ENGINE INOP

**Decompression Critical Fuel Reserves - LRC Cruise
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEAD WIND COMPONENT (KTS)						TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
283	262	243	227	213	200	189	179	170	162	155
570	526	487	454	425	400	377	357	339	323	308
857	790	732	682	638	600	566	536	508	484	462
1144	1053	976	909	851	800	755	714	678	645	615
1431	1317	1221	1137	1064	1000	943	892	847	806	769
1718	1581	1465	1365	1277	1200	1132	1071	1016	967	922
2005	1845	1709	1592	1490	1400	1320	1249	1185	1128	1075
2292	2109	1954	1820	1703	1600	1509	1428	1355	1289	1229
2579	2373	2198	2047	1916	1800	1697	1606	1524	1450	1382
2866	2637	2443	2275	2129	2000	1886	1784	1693	1611	1536
3153	2901	2687	2502	2342	2200	2075	1963	1862	1772	1689
3440	3165	2932	2730	2554	2400	2263	2141	2032	1933	1843
3727	3429	3176	2958	2767	2600	2452	2320	2201	2094	1996
4014	3693	3421	3185	2980	2800	2640	2498	2370	2255	2150
4300	3957	3665	3413	3193	3000	2829	2676	2539	2416	2303

Critical Fuel (1000 LB)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 LB)											
	380	420	460	500	540	580	620	660	700	740	780	
200	9.3	9.8	10.3	10.8	11.2	11.7	12.2	12.8	13.3	13.8	14.3	
400	17.1	18.1	19.0	19.9	20.8	21.6	22.5	23.4	24.3	25.2	26.1	
600	24.9	26.2	27.5	28.8	30.0	31.3	32.5	33.8	35.1	36.3	37.5	
800	32.3	34.1	35.8	37.5	39.2	40.8	42.4	44.1	45.8	47.4	49.0	
1000	39.8	42.0	44.1	46.2	48.3	50.3	52.3	54.4	56.4	58.4	60.4	
1200	47.2	49.8	52.4	55.0	57.4	59.8	62.2	64.6	67.1	69.4	71.7	
1400	54.6	57.7	60.7	63.7	66.4	69.1	71.8	74.6	77.3	80.1	82.7	
1600	62.1	65.5	68.8	72.0	75.2	78.3	81.3	84.4	87.6	90.7	93.8	
1800	69.2	72.9	76.6	80.3	83.9	87.4	90.8	94.3	97.9	101.4	104.9	
2000	76.2	80.3	84.5	88.6	92.6	96.5	100.4	104.2	108.1	111.9	115.6	
2200	83.2	87.8	92.4	96.9	101.3	105.6	109.7	113.8	118.0	122.1	126.3	
2400	90.2	95.2	100.2	105.2	109.8	114.3	118.8	123.3	127.9	132.4	136.9	
2600	97.2	102.6	107.9	113.0	118.1	123.0	127.9	132.8	137.7	142.7	147.5	
2800	104.3	109.7	115.3	120.9	126.4	131.7	137.0	142.3	147.5	152.7	157.8	
3000	111.3	116.7	122.7	128.7	134.7	140.5	146.1	151.5	157.0	162.6	168.1	

Based on: Emergency descent to 10000 ft, level cruise at 10000 ft, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn

- Adjustments:
- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
 - Increase fuel required 0.7% per 10°C above ISA.
 - When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (10%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

ENGINE INOP**Driftdown Critical Fuel Reserves - LRC Driftdown/Cruise
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
261	246	232	220	209	200	191	182	175	168	162
523	492	465	441	419	400	381	365	350	336	323
786	740	699	662	629	600	572	547	525	504	484
1050	988	933	884	840	800	763	730	699	671	645
1316	1237	1168	1106	1050	1000	954	912	874	838	806
1582	1487	1403	1328	1260	1200	1144	1094	1048	1005	966
1848	1737	1638	1550	1471	1400	1335	1276	1222	1172	1126
2116	1987	1874	1772	1682	1600	1525	1457	1395	1338	1286
2383	2238	2110	1995	1892	1800	1715	1639	1569	1505	1445
2651	2489	2346	2218	2103	2000	1906	1820	1742	1671	1605
2920	2740	2582	2440	2314	2200	2096	2002	1916	1837	1764
3188	2992	2818	2663	2524	2400	2286	2183	2089	2003	1924
3457	3243	3054	2886	2735	2600	2477	2365	2263	2169	2083
3726	3494	3290	3109	2946	2800	2667	2546	2436	2335	2242
3994	3746	3526	3331	3157	3000	2857	2728	2610	2501	2401

Critical Fuel (1000 LB)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 LB)										
	380	420	460	500	540	580	620	660	700	740	780
200	10.7	11.2	11.8	12.3	12.5	12.9	13.3	13.8	14.2	14.7	15.0
400	16.9	18.0	19.1	20.2	21.0	21.9	22.8	23.8	24.8	26.0	26.9
600	22.8	24.5	26.1	27.7	29.0	30.5	31.9	33.5	35.0	36.8	38.3
800	28.6	30.8	33.0	35.1	36.9	38.9	40.9	43.0	45.1	47.5	49.6
1000	34.4	37.1	39.8	42.4	44.8	47.3	49.8	52.4	55.0	58.0	60.6
1200	40.0	43.2	46.5	49.6	52.5	55.5	58.6	61.7	64.8	68.3	71.6
1400	45.5	49.3	53.0	56.7	60.1	63.7	67.2	70.8	74.5	78.6	82.4
1600	51.0	55.2	59.5	63.7	67.7	71.8	75.8	79.9	84.0	88.7	93.0
1800	56.4	61.1	65.9	70.6	75.1	79.7	84.2	88.8	93.5	98.7	103.6
2000	61.7	67.0	72.2	77.4	82.5	87.6	92.6	97.7	102.8	108.5	114.0
2200	67.0	72.7	78.4	84.2	89.7	95.4	100.9	106.4	112.1	118.3	124.3
2400	72.2	78.4	84.6	90.8	96.9	103.1	109.1	115.0	121.2	127.9	134.4
2600	77.3	84.0	90.7	97.4	104.0	110.7	117.2	123.6	130.2	137.5	144.5
2800	82.4	89.6	96.7	103.9	111.1	118.2	125.2	132.1	139.2	146.9	154.4
3000	87.4	95.0	102.6	110.4	118.0	125.6	133.1	140.4	148.0	156.3	164.3

Based on: Driftdown to and cruise at level off altitude, 250 KIAS descent to 1500 ft, 15 minutes hold at 1500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required 0.7% per 10°C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (12%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

Intentionally
Blank

Performance Dispatch

Chapter PD

Landing

Section 62

Landing Field Limit Weight - Dry Runway
Flaps 30

Wind Adjusted Field Length (FT)

FIELD LENGTH AVAILABLE (FT)	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
3000			2750	3000	3070	3080	3140	3200
3400	2700	2870	3110	3400	3500	3540	3640	3730
3800	2990	3200	3470	3800	3930	4000	4130	4260
4200	3280	3530	3830	4200	4360	4460	4630	4790
4600	3570	3850	4190	4600	4790	4920	5120	5320
5000	3860	4180	4550	5000	5220	5380	5620	5860
5400	4150	4510	4910	5400	5650	5840	6120	6390
5800	4450	4840	5270	5800	6080	6300	6610	6920
6200	4740	5160	5630	6200	6500	6760	7110	7450
6600	5030	5490	5990	6600	6930	7210	7600	7980
7000	5320	5820	6350	7000	7360	7670	8100	8520
7400	5610	6150	6710	7400	7790	8130	8600	9050
7800	5900	6470	7070	7800	8220	8590	9090	9580
8200	6190	6800	7430	8200	8650	9050	9590	10110
8600	6480	7130	7790	8600	9080	9510	10080	10650
9000	6770	7450	8150	9000	9510	9970	10580	11180
9400	7060	7780	8510	9400	9940	10430	11080	11710
9800	7350	8110	8870	9800	10370	10890	11570	12240
10200	7650	8440	9230	10200	10800	11350	12070	12770
10600	7940	8760	9590	10600	11230	11800	12560	13310

Landing Field Limit Weight - Dry Runway

Flaps 30

Field Limit Weight (1000 LB)

WIND CORRECTED FIELD LENGTH (FT)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
4600	403.3				
5000	451.4	423.9	397.7		
5400	502.1	470.6	440.9	413.4	387.0
5800	553.3	518.9	486.1	454.7	425.8
6200	605.0	567.7	532.0	498.0	465.5
6600	649.4	616.8	578.4	541.7	506.6
7000	670.9	653.4	625.1	585.6	548.0
7400	690.1	672.5	655.1	629.9	589.7
7800	706.4	687.6	669.9	652.2	629.6
8200	723.8	702.2	683.9	666.1	647.6
8600	740.7	718.2	697.1	679.0	661.0
9000	756.7	733.8	711.5	691.4	673.2
9400	779.5	748.8	725.9	703.6	684.6
9800	796.2	764.7	739.8	716.9	695.6
10200	812.3	784.9	753.2	729.9	707.1
10600	827.8	799.9	770.6	742.3	718.9
11000	843.1	814.3	786.5	754.3	730.6
11400		828.3	800.0	770.2	741.8
11800		842.1	813.1	784.9	752.6
12200			825.7	797.1	764.5
12600			838.0	808.9	780.5
13000			850.3	820.3	791.6
13400				831.5	802.2
13800				842.6	812.6
14200				853.7	822.8
14600					832.9

With manual speedbrakes, decrease weight by 47800 lb.

With 1 brake deactivated, decrease weight by 50200 lb.

With 2 brakes deactivated, decrease weight by 102100 lb.

Landing Field Limit Weight - Wet Runway

Flaps 30

Wind Adjusted Field Length (FT)

FIELD LENGTH AVAILABLE (FT)	WIND COMPONENT (KTS)							
	-15	-10	-5	0	10	20	30	40
3000				3000	3050	3030	3050	3080
3400			3120	3400	3480	3490	3550	3610
3800	3020	3210	3480	3800	3910	3950	4050	4140
4200	3320	3540	3840	4200	4340	4410	4540	4670
4600	3610	3870	4200	4600	4770	4870	5040	5200
5000	3900	4200	4560	5000	5190	5320	5530	5740
5400	4190	4520	4920	5400	5620	5780	6030	6270
5800	4480	4850	5280	5800	6050	6240	6520	6800
6200	4770	5180	5640	6200	6480	6700	7020	7330
6600	5060	5500	6000	6600	6910	7160	7520	7870
7000	5350	5830	6360	7000	7340	7620	8010	8400
7400	5640	6160	6720	7400	7770	8080	8510	8930
7800	5930	6490	7080	7800	8200	8540	9010	9460
8200	6220	6810	7440	8200	8630	9000	9500	9990
8600	6520	7140	7800	8600	9060	9460	10000	10530
9000	6810	7470	8160	9000	9490	9910	10490	11060
9400	7100	7800	8520	9400	9920	10370	10990	11590
9800	7390	8120	8880	9800	10340	10830	11480	12120
10200	7680	8450	9240	10200	10770	11290	11980	12660
10600	7970	8780	9600	10600	11200	11750	12480	13190

Field Limit Weight (1000 LB)

WIND CORRECTED FIELD LENGTH (FT)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
5400	414.8	389.4			
5800	456.9	428.9	402.4		
6200	501.0	469.6	440.0	412.5	386.2
6600	545.5	511.6	479.1	448.4	419.9
7000	590.3	553.9	519.0	485.7	454.1
7400	634.1	596.5	559.2	523.6	489.6
7800	659.4	638.5	599.7	561.7	525.4
8200	677.6	660.0	637.8	600.1	561.6
8600	693.1	675.5	658.0	635.2	597.9
9000	707.6	688.6	670.8	653.1	630.8
9400	722.7	701.2	683.0	665.2	646.4
9800	737.4	715.1	694.6	676.5	658.5
10200	751.5	728.8	706.7	687.4	669.2
10600	768.6	742.0	719.3	697.9	679.5
11000	786.5	754.8	731.7	709.2	689.2
11400	800.8	771.7	743.6	720.6	698.7
11800	814.7	787.2	755.1	731.8	708.9
12200	828.1	800.2	771.0	742.6	719.2
12600	841.5	812.8	785.0	753.0	729.4
13000	854.8	825.0	796.8	765.4	739.2
13400		837.0	808.3	780.3	748.7
13800		849.1	819.5	791.1	757.9
14200			830.2	801.5	772.2
14600			840.9	811.7	783.2

With manual speedbrakes, decrease weight by 47800 lb.

With 1 brake deactivated, decrease weight by 50200 lb.

With 2 brakes deactivated, decrease weight by 102100 lb.

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 LB)					
		AIRPORT PRESSURE ALTITUDE (FT)					
(°C)	(°F)	-2000	0	2000	4000	6000	8000
54	129	672.3	628.0				
52	126	690.0	643.1				
50	122	707.8	659.3	605.6			
48	118	725.5	677.8	619.9			
46	115	743.7	696.5	635.4	585.0		
44	111	761.0	714.1	652.5	600.2		
42	108	777.3	732.3	671.6	614.6	563.6	
40	104	793.0	750.7	689.9	629.6	576.5	
38	100	809.0	769.5	707.1	644.2	589.2	523.7
36	97	823.4	785.6	722.9	658.1	600.0	534.2
34	93	834.9	801.0	739.6	671.9	609.6	544.6
32	90	835.0	816.7	753.4	684.7	618.5	554.2
30	86	835.0	830.3	765.2	699.0	627.8	562.5
28	82	835.0	830.6	775.5	709.9	638.0	570.7
26	79	835.0	830.8	787.4	718.4	648.3	578.8
24	75	835.0	831.0	787.5	725.5	659.0	587.6
22	72	835.0	831.2	787.7	732.4	666.4	596.9
20	68	835.0	831.5	787.8	732.6	671.0	604.8
18	64	835.0	831.6	788.0	732.8	675.5	610.3
16	61	835.0	831.8	788.2	732.9	675.6	614.2
14	57	835.0	831.9	788.4	733.1	675.8	617.6
12	54	835.0	832.1	788.5	733.3	675.9	617.8
10	50	835.0	832.1	788.7	733.4	675.9	617.9
8	46	835.0	832.2	788.9	733.6	676.0	617.9
6	43	835.0	832.3	788.9	733.7	676.0	617.8
4	40	835.0	832.4	781.7	706.6	645.9	570.9
2	36	835.0	832.4	781.9	706.7	646.0	570.9
0	32	835.0	832.5	781.9	706.8	646.1	571.0
-40	-40	835.0	832.7	781.9	706.8	646.1	571.1

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.

With engine bleed for packs off, increase weight by 2900 lb.

With engine and wing anti-ice on, decrease weight by 4800 lb.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 48400 lb.

ENGINE INOP**ADVISORY INFORMATION****Go-Around Climb Gradient****Flaps 20, Gear Up**

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.

OAT (°C)	REFERENCE GO-AROUND GRADIENT (%)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
54	6.10	5.13	3.96			
50	6.87	5.86	4.59	3.52	2.51	1.16
46	7.69	6.66	5.32	4.11	3.04	1.64
42	8.44	7.49	6.11	4.83	3.61	2.13
38	9.17	8.30	6.86	5.49	4.19	2.65
34	9.62	9.05	7.54	6.08	4.67	3.14
30	9.64	9.64	8.07	6.61	5.10	3.54
26	9.66	9.65	8.51	7.03	5.59	3.93
22	9.67	9.66	8.52	7.34	5.93	4.36
18	9.69	9.66	8.52	7.34	6.15	4.65
14	9.71	9.67	8.53	7.35	6.15	4.84
10	9.72	9.68	8.54	7.35	6.15	4.84

Weight Adjustment

WEIGHT (1000 LB)	REFERENCE GO-AROUND GRADIENT (%)										
	0	1	2	3	4	5	6	7	8	9	10
800	-3.08	-3.51	-3.94	-4.37	-4.80	-5.22	-5.64	-6.05	-6.46	-6.86	-7.26
750	-2.74	-3.13	-3.52	-3.90	-4.28	-4.65	-5.03	-5.40	-5.76	-6.12	-6.47
700	-2.41	-2.74	-3.07	-3.40	-3.72	-4.04	-4.36	-4.68	-4.99	-5.30	-5.60
650	-2.08	-2.35	-2.61	-2.87	-3.12	-3.38	-3.63	-3.88	-4.13	-4.39	-4.64
600	-1.51	-1.70	-1.89	-2.08	-2.26	-2.45	-2.63	-2.81	-2.99	-3.18	-3.37
550	-0.83	-0.93	-1.04	-1.14	-1.24	-1.34	-1.44	-1.54	-1.64	-1.74	-1.85
500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
450	1.03	1.16	1.28	1.40	1.53	1.65	1.77	1.90	2.03	2.16	2.29
400	2.38	2.66	2.93	3.21	3.49	3.77	4.06	4.35	4.64	4.95	5.26

Speed Adjustment

SPEED (KIAS)	WEIGHT ADJUSTED GO-AROUND GRADIENT (%)										
	0	1	2	3	4	5	6	7	8	9	10
VREF	-0.22	-0.23	-0.23	-0.23	-0.23	-0.22	-0.22	-0.22	-0.21	-0.21	-0.21
VREF+5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VREF+10	0.08	0.07	0.07	0.07	0.09	0.11	0.12	0.11	0.12	0.10	0.10
VREF+20	0.17	0.14	0.12	0.13	0.16	0.19	0.19	0.17	0.17	0.14	0.13
VREF+30	0.14	0.10	0.08	0.08	0.10	0.05	0.03	0.01	-0.01	-0.07	-0.04

With engine bleed for packs off, increase gradient by 0.1%.

With engine and wing anti-ice on, decrease gradient by 0.1%.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease gradient by 0.7%

Quick Turnaround Limit Weight

Flaps 30 Limit Weight (1000 LB)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	510.4				
50	122	513.7	494.5			
45	113	517.9	498.5	479.9		
40	104	522.2	502.6	483.7	465.1	
35	95	526.6	506.8	487.7	469.0	450.5
30	86	531.1	511.2	491.8	473.1	454.4
25	77	535.6	515.6	496.1	477.3	458.4
20	68	540.3	520.2	500.4	481.5	462.5
15	59	545.2	524.9	504.9	485.7	466.8
10	50	550.2	529.7	509.6	490.1	471.1
5	41	555.3	534.6	514.3	494.6	475.5
0	32	560.6	539.6	519.2	499.3	480.1
-5	23	566.1	544.8	524.3	504.1	484.6
-10	14	571.7	550.2	529.5	509.1	489.3
-15	5	577.5	555.7	534.7	514.2	494.2
-20	-4	583.4	561.5	540.1	519.5	499.2
-30	-22	595.8	573.4	551.6	530.5	509.8
-40	-40	608.4	586.1	563.8	542.1	521.1
-50	-58	622.0	599.4	576.8	554.5	532.9
-54	-65	627.7	604.9	582.2	559.8	537.7

Increase weight by 4800 lb per 1% uphill slope. Decrease weight by 7600 lb per 1% downhill slope.

Increase weight by 13200 lb per 10 knots headwind. Decrease weight by 69500 lb per 10 knots tailwind.

Decrease weight by 27600 lb when one brake is deactivated. Decrease weight by 56100 lb when two brakes are deactivated.

After landing at weights exceeding those shown above, adjusted for slope and wind, wait at least 65 minutes and check that wheel thermal plugs have not melted before executing a takeoff.

As an alternate procedure, no waiting period is required if the BRAKE TEMP advisory message on EICAS is not displayed 10 to 15 minutes after parking.

Performance Dispatch**Chapter PD****Gear Down****Section 63****GEAR DOWN****Takeoff Climb Limit Weight****Flaps 15**

AIRPORT OAT		TAKEOFF CLIMB WEIGHT (1000 LB)				
		AIRPORT PRESSURE ALTITUDE (FT)				
°C	°F	0	2000	4000	6000	8000
54	129	517.8	494.0	458.7	412.7	
52	126	529.7	493.8	471.7	424.7	
50	122	542.4	496.4	473.5	436.5	377.2
48	118	555.5	508.7	473.4	447.8	388.6
46	115	568.6	520.8	475.9	448.8	399.8
44	111	581.5	532.6	486.8	448.6	410.6
42	108	593.6	544.2	497.7	451.1	416.5
40	104	605.9	556.3	508.9	461.3	416.3
38	100	619.5	569.1	520.9	471.9	418.8
36	97	633.2	581.8	532.9	483.2	428.4
34	93	647.1	594.8	545.3	494.8	438.3
32	90	659.4	607.7	557.5	506.1	448.8
30	86	671.1	621.1	569.7	517.9	459.9
28	82	683.0	634.3	582.3	529.5	470.5
26	79	693.7	646.4	593.8	540.9	481.9
24	75	699.0	657.0	604.2	551.5	492.3
22	72	699.2	666.6	614.1	560.7	503.6
20	68	699.4	671.1	622.4	568.3	513.5
18	65	699.6	671.2	630.2	575.3	521.5
16	61	699.7	671.2	634.0	580.4	528.3
14	58	699.8	671.2	633.9	584.6	534.3
10	50	700.0	671.3	633.6	586.4	540.4
-40	-40	696.2	666.9	627.1	579.2	535.1

With engine bleed for packs off, increase weight by 1800 lb.

With engine anti-ice on, decrease weight by 4000 lb.

With engine and wing anti-ice on, decrease weight by 9200 lb.

GEAR DOWN

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 LB)				
		AIRPORT PRESSURE ALTITUDE (FT)				
(°C)	(°F)	0	2000	4000	6000	8000
54	129	565.0				
52	126	578.9				
50	122	592.7	544.9			
48	118	607.7	558.2			
46	115	623.2	572.8	527.0		
44	111	638.1	588.5	541.2		
42	108	653.6	603.6	554.3	507.6	
40	104	669.5	618.4	567.9	519.1	
38	100	684.8	631.1	580.5	530.6	470.4
36	97	699.4	643.8	591.9	539.9	480.0
34	93	714.0	657.3	601.9	548.5	489.6
32	90	727.3	668.9	612.0	556.3	497.9
30	86	740.1	679.4	622.6	564.9	505.5
28	82	740.3	688.5	632.0	574.0	512.8
26	79	740.5	698.7	639.1	583.5	520.2
24	75	740.7	698.8	644.5	591.9	528.4
22	72	740.9	698.9	650.1	597.5	536.7
20	68	741.1	699.1	650.3	601.0	543.9
18	64	741.3	699.3	650.4	604.6	548.8
16	61	741.5	699.4	650.5	604.7	552.2
14	57	741.6	699.6	650.6	604.8	555.4
12	54	741.7	699.8	650.6	604.8	555.5
10	50	741.8	699.9	650.7	604.8	555.6
-40	-40	742.3	700.4	651.4	605.4	556.0

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.

With engine bleed for packs off, increase weight by 3900 lb.

With engine and wing anti-ice on, decrease weight by 3800 lb.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 67500 lb.

GEAR DOWN**Takeoff Obstacle Limit Weight****Flaps 15****Sea Level, 30°C & Below, Zero Wind****Based on engine bleed for packs on, engine and wing anti-ice off**

OBSTACLE HEIGHT (FT)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 LB)								
	DISTANCE FROM BRAKE RELEASE (1000 FT)								
	8	10	12	14	16	18	20	22	24
10	647.4								
50	607.6	666.0							
100	570.3	627.7	668.4						
150	541.1	597.0	638.7	669.6					
200	516.9	571.3	613.6	645.4	670.1				
250	496.0	549.2	591.3	624.2	649.8	670.3			
300	477.4	529.7	571.5	605.0	631.6	652.9	670.4	681.7	681.7
350	460.9	512.3	553.8	587.4	614.8	636.8	655.0	670.2	681.0
400	445.9	496.5	537.7	571.4	599.1	622.0	640.7	656.5	670.0
450	432.4	482.0	522.9	556.6	584.6	607.9	627.4	643.7	657.7
500	419.8	468.6	509.2	542.8	571.0	594.7	614.7	631.6	646.0
550	408.1	456.2	496.5	530.0	558.3	582.3	602.7	620.1	634.9
600	397.2	444.7	484.5	518.1	546.4	570.5	591.3	609.0	624.3
650	387.0	434.0	473.3	506.8	535.1	559.4	580.4	598.4	614.1
700	377.4	423.9	462.8	496.1	524.5	548.9	570.0	588.4	604.3
750		414.4	452.8	486.0	514.4	538.8	560.1	578.7	594.9
800		405.3	443.5	476.3	504.7	529.2	550.6	569.4	585.9
850		396.7	434.6	467.2	495.5	520.1	541.6	560.4	577.1
900		388.5	426.2	458.5	486.7	511.3	532.9	551.9	568.7
950		380.7	418.2	450.1	478.3	502.9	524.5	543.6	560.6
1000		373.3	410.4	442.3	470.2	494.8	516.5	535.7	552.7

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustments

OAT (°C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 LB)								
	360	400	440	480	520	560	600	640	680
30 & BELOW	0	0	0	0	0	0	0	0	0
32	-6.3	-7.1	-7.9	-8.8	-9.6	-10.4	-11.3	-12.1	-12.9
34	-12.5	-14.2	-15.9	-17.5	-19.2	-20.9	-22.5	-24.2	-25.8
36	-18.8	-21.3	-23.8	-26.3	-28.8	-31.3	-33.8	-36.3	-38.8
38	-25.1	-28.4	-31.7	-35.1	-38.4	-41.7	-45.0	-48.4	-51.7
40	-31.4	-35.5	-39.7	-43.8	-48.0	-52.1	-56.3	-60.5	-64.6
42	-37.5	-42.5	-47.5	-52.5	-57.6	-62.6	-67.6	-72.7	-77.7
44	-43.5	-49.5	-55.4	-61.3	-67.2	-73.1	-79.0	-84.9	-90.8
46	-49.6	-56.4	-63.2	-70.0	-76.8	-83.6	-90.3	-97.1	-103.9
48	-55.7	-63.4	-71.0	-78.7	-86.4	-94.0	-101.7	-109.3	-117.0
50	-61.8	-70.4	-78.9	-87.4	-96.0	-104.5	-113.0	-121.6	-130.1

GEAR DOWN

Takeoff Obstacle Limit Weight

Flaps 15

Pressure Altitude Adjustments

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 LB)								
	360	400	440	480	520	560	600	640	680
S.L. & BELOW	0	0	0	0	0	0	0	0	0
1000	-15.3	-16.7	-18.1	-19.5	-20.9	-22.3	-23.7	-25.1	-26.5
2000	-30.7	-33.5	-36.3	-39.1	-41.9	-44.7	-47.5	-50.3	-53.1
3000	-43.7	-48.0	-52.4	-56.7	-61.0	-65.3	-69.6	-73.9	-78.2
4000	-56.8	-62.6	-68.5	-74.3	-80.1	-85.9	-91.7	-97.5	-103.4
5000	-72.4	-79.7	-87.0	-94.3	-101.6	-108.9	-116.3	-123.6	-130.9
6000	-87.9	-96.7	-105.5	-114.3	-123.2	-132.0	-140.8	-149.6	-158.4
7000	-102.1	-112.5	-122.9	-133.3	-143.7	-154.1	-164.5	-174.9	-185.4
8000	-116.3	-128.3	-140.3	-152.3	-164.3	-176.3	-188.3	-200.3	-212.3

Wind Adjustments

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 LB)								
	360	400	440	480	520	560	600	640	680
15 TW	-38.3	-42.0	-45.7	-49.3	-53.0	-56.7	-60.3	-64.0	-67.7
10 TW	-25.6	-28.0	-30.4	-32.9	-35.3	-37.8	-40.2	-42.7	-45.1
5 TW	-12.8	-14.0	-15.2	-16.4	-17.7	-18.9	-20.1	-21.3	-22.6
0	0	0	0	0	0	0	0	0	0
10 HW	8.0	7.6	7.1	6.7	6.3	5.9	5.4	5.0	4.6
20 HW	16.0	15.1	14.3	13.4	12.6	11.7	10.9	10.0	9.1
30 HW	26.0	24.6	23.1	21.7	20.3	18.9	17.4	16.0	14.6
40 HW	36.0	34.0	32.0	30.0	28.0	26.0	24.0	22.0	20.0

With engine bleed for packs off, increase weight by 2100 lb.

With engine anti-ice on, decrease weight by 3600 lb.

With engine and wing anti-ice on, decrease weight by 8700 lb.

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
780	18600	16600	14200
760	19100	17200	14800
740	19700	17900	15500
720	20200	18500	16100
700	21000	19400	17100
680	21900	20400	18200
660	22900	21500	19400
640	23900	22500	20600
620	25000	23500	21900
600	25900	24600	23000
580	27000	25700	24200
560	28000	27000	25400
540	29100	28200	26700
520	30100	29500	28000
500	30900	30500	29300
480	31600	31300	30500
460	32400	32200	31500
440	33300	33100	32600
420	34100	33900	33600
400	34900	34800	34600
380	35800	35700	35600
360	36700	36600	36400

GEAR DOWN

**Long Range Cruise Trip Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
334	296	264	239	218	200	187	175	165	156	149
500	444	396	358	327	300	281	264	249	235	224
666	591	527	477	436	400	375	352	332	314	299
830	738	659	596	545	500	469	441	416	393	374
993	883	789	714	653	600	563	530	500	473	450
1156	1029	920	833	762	700	657	618	583	552	525
1318	1173	1050	951	870	800	751	707	667	632	601
1479	1318	1179	1069	979	900	845	796	751	712	677
1639	1462	1309	1187	1087	1000	939	884	835	791	753
1799	1605	1438	1305	1196	1100	1033	973	919	871	829
1958	1748	1567	1423	1304	1200	1128	1062	1003	951	905
2116	1890	1696	1540	1412	1300	1222	1151	1087	1030	981
2273	2032	1824	1658	1520	1400	1316	1240	1171	1110	1058
2430	2174	1952	1775	1628	1500	1410	1329	1255	1191	1134
2586	2315	2080	1892	1736	1600	1504	1418	1340	1271	1211
2741	2455	2208	2009	1844	1700	1599	1507	1425	1351	1287
2896	2595	2335	2125	1952	1800	1693	1596	1509	1432	1364
3050	2734	2461	2242	2060	1900	1788	1686	1594	1512	1441
3203	2873	2588	2358	2167	2000	1882	1776	1679	1593	1518

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	17.3	0:52	16.6	0:50	16.1	0:48	15.8	0:46	15.6	0:45
300	25.3	1:15	24.2	1:12	23.3	1:09	22.5	1:06	22.1	1:03
400	33.4	1:39	31.7	1:34	30.4	1:30	29.2	1:25	28.5	1:21
500	41.4	2:02	39.2	1:56	37.5	1:50	36.0	1:45	35.0	1:40
600	49.7	2:25	47.1	2:18	44.9	2:11	43.0	2:04	41.7	1:58
700	58.1	2:48	54.9	2:39	52.3	2:31	50.0	2:23	48.4	2:16
800	66.4	3:11	62.7	3:01	59.7	2:51	57.0	2:42	55.1	2:34
900	74.8	3:33	70.5	3:22	67.1	3:12	64.0	3:02	61.8	2:52
1000	83.1	3:56	78.4	3:44	74.5	3:32	71.0	3:21	68.5	3:10
1100	91.8	4:18	86.6	4:05	82.2	3:52	78.4	3:39	75.6	3:27
1200	100.6	4:40	94.8	4:25	90.0	4:11	85.7	3:58	82.7	3:45
1300	109.3	5:02	103.0	4:46	97.7	4:31	93.1	4:16	89.7	4:02
1400	118.1	5:24	111.2	5:07	105.4	4:51	100.4	4:35	96.8	4:19
1500	126.8	5:46	119.4	5:28	113.2	5:10	107.8	4:53	103.9	4:37
1600	136.0	6:07	128.0	5:48	121.2	5:29	115.5	5:11	111.4	4:54
1700	145.2	6:28	136.5	6:08	129.3	5:48	123.2	5:29	118.8	5:11
1800	154.3	6:49	145.1	6:28	137.4	6:07	130.9	5:47	126.3	5:28
1900	163.5	7:10	153.7	6:48	145.5	6:26	138.6	6:05	133.8	5:45
2000	172.6	7:32	162.3	7:08	153.6	6:45	146.3	6:23	141.3	6:02

GEAR DOWN**Long Range Cruise Trip Fuel and Time****Fuel Required Adjustment (1000 LB)**

REFERENCE FUEL REQUIRED (1000 LB)	LANDING WEIGHT (1000 LB)					
	350	400	450	500	550	600
20	-2.4	-1.2	0.0	1.5	3.0	4.6
40	-4.7	-2.4	0.0	2.9	5.9	9.2
60	-7.1	-3.6	0.0	4.4	8.9	13.9
80	-9.5	-4.9	0.0	5.9	12.0	18.8
100	-11.9	-6.1	0.0	7.4	15.2	23.7
120	-14.3	-7.3	0.0	9.0	18.4	28.9
140	-16.7	-8.5	0.0	10.6	21.8	34.1
160	-19.1	-9.7	0.0	12.2	25.1	39.4
180	-21.6	-10.9	0.0	13.8	28.6	44.9

Based on VREF+80 climb, Long Range Cruise and VREF+80 descent.

Short Trip Fuel and Time**Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
105	86	73	63	56	50	45	41	38	35	33
174	152	134	120	109	100	92	85	80	75	70
245	217	195	177	163	150	139	130	122	115	108
314	282	256	234	216	200	186	175	164	155	147
384	347	316	290	269	250	234	219	207	196	185
452	411	376	347	322	300	281	264	250	236	224
521	474	436	403	375	350	328	309	292	277	264
590	539	496	459	428	400	376	354	335	318	303
659	603	556	515	480	450	423	399	378	359	342
730	668	616	572	534	500	470	444	421	399	380

Trip Fuel and Time

AIR DISTANCE (NM)		LANDING WEIGHT (1000 LB)						TIME (HRS:MIN)
		360	400	440	480	520	560	
50	FUEL (1000 LB)	4.9	5.1	5.4	5.7	6.0	6.4	0:16
	ALT (FT)	11000	11000	11000	11000	11000	9000	
100	FUEL (1000 LB)	8.0	8.5	9.0	9.5	10.0	10.6	0:26
	ALT (FT)	21000	21000	19000	19000	19000	17000	
150	FUEL (1000 LB)	10.8	11.5	12.2	13.0	13.7	14.5	0:35
	ALT (FT)	27000	25000	25000	23000	23000	21000	
200	FUEL (1000 LB)	13.5	14.4	15.3	16.3	17.3	18.3	0:44
	ALT (FT)	33000	29000	27000	27000	25000	23000	
250	FUEL (1000 LB)	16.0	17.2	18.4	19.6	20.9	22.2	0:52
	ALT (FT)	33000	31000	29000	27000	25000	23000	
300	FUEL (1000 LB)	18.6	20.0	21.5	23.0	24.5	26.0	1:01
	ALT (FT)	33000	33000	29000	29000	27000	25000	
350	FUEL (1000 LB)	21.2	22.8	24.5	26.3	28.0	29.8	1:09
	ALT (FT)	33000	33000	31000	29000	27000	25000	
400	FUEL (1000 LB)	23.8	25.7	27.6	29.6	31.6	33.7	1:17
	ALT (FT)	33000	33000	31000	29000	27000	25000	
450	FUEL (1000 LB)	26.5	28.5	30.7	33.0	35.3	37.6	1:26
	ALT (FT)	33000	33000	31000	29000	27000	25000	
500	FUEL (1000 LB)	29.1	31.4	33.8	36.3	38.9	41.5	1:34
	ALT (FT)	33000	33000	31000	29000	27000	25000	

GEAR DOWN

Holding Planning
Flaps Up

WEIGHT (1000 LB)	TOTAL FUEL FLOW (LB/HR)						
	PRESSURE ALTITUDE (FT)						
	1500	5000	10000	15000	20000	25000	30000
800	34550						
760	33390	33420					
720	31570	31530					
680	29640	29580	29490				
640	27710	27670	27560				
600	26100	26080	25930				
560	24550	24520	24350	24470			
520	23040	22970	22800	22860	23100		
480	21610	21500	21320	21320	21540		
440	20150	20000	19800	19790	19950	20220	
400	18760	18580	18340	18340	18430	18570	19050
360	17350	17150	16890	16860	16880	17000	17360

Flaps 1

WEIGHT (1000 LB)	TOTAL FUEL FLOW (LB/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
800	33920	34110	34060	34600	36410
760	32630	32740	32680	33150	34530
720	30740	30780	30750	31090	32130
680	28770	28780	28750	28990	29710
640	26830	26830	26770	27030	27540
600	25180	25160	25060	25310	25710
560	23580	23520	23400	23620	23890
520	22000	21900	21750	21910	22150
480	20490	20340	20180	20260	20480
440	18960	18770	18570	18610	18790
400	17490	17280	17030	17010	17140
360	16020	15800	15520	15420	15520

These tables include 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 LB)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
20	374.5	374.5	
18	397.5	393.1	384.4
16	424.4	420.7	412.2
14	453.3	451.7	440.3
12	488.9	484.2	469.7
10	524.5	518.7	503.5
8	562.0	553.8	539.5
6	604.3	588.9	567.4
4	641.4	617.7	589.7
2	671.4	642.9	613.1
0	698.4	666.6	634.4

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 LB)									
	PRESSURE ALTITUDE (1000 FT)									
	0	2	4	6	8	10	12	14	16	18
ENGINE ONLY	0.0	-1.3	-2.2	-2.4	-2.1	-1.7	-1.4	-0.2	0.0	0.0
ENGINE AND WING	-4.7	-6.2	-6.3	-6.6	-5.7	-4.9	-4.0	-3.3	-2.6	-2.0

Intentionally
Blank

Performance Dispatch**Text****Chapter PD****Section 64**

Introduction

This chapter contains self dispatch performance data intended primarily for use by flight crews in the event that information cannot be obtained from the airline dispatch office. The data provided is for a single takeoff flap at max takeoff thrust. The range of conditions covered is limited to those normally encountered in airline operation. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

Takeoff

The maximum allowable takeoff weight will be the least of the Field, Climb, Tire Speed, and Obstacle Limit Weights as determined from the following tables. Brake Energy Limit is not shown as it is not limiting for the range of conditions shown in this chapter. When determining a maximum weight for a wet runway, the dry runway limit weight must also be checked and the lower of the two weights used.

Field Limit Weight - Slope and Wind Corrections

These tables for wet and dry runways provide corrections to the field length available for the effects of runway slope and wind component along the runway. Enter the Slope Correction table with the available field length and runway slope to determine the slope corrected field length. Now enter the Wind Correction table with slope corrected field length and wind component to determine the slope and wind corrected field length.

Field and Climb Limit Weight

Tables are presented for selected airport pressure altitudes and runway condition and show both Field and Climb Limit Weights. Enter the appropriate table for pressure altitude and runway condition with “Slope and Wind Corrected Field Length” determined above and airport OAT to obtain Field Limit Weight. Also read Climb Limit Weight for the same OAT. Intermediate altitudes may be interpolated or use next higher altitude.

When finding a maximum weight for a wet runway, the dry runway limit weight must also be determined and the lower of the two weights used.

Obstacle Limit Weight

This table provides obstacle limit weights for reference airport conditions based on obstacle height above the runway surface and distance from brake release. Enter the correction tables to correct the reference Obstacle Limit Weight for the effects of OAT, pressure altitude and wind as indicated. In the case of multiple obstacles, enter the tables successively with each obstacle and determine the most limiting weight.

Tire Speed Limit

Maximum tire speed limited weights are presented for 235 MPH tires. To determine the tire speed limit weight, enter the table with OAT, move to airport pressure altitude and read the tire speed limit weight. Adjust the tire speed limit weight according to the notes below the table to account for wind.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table as well as FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Normal takeoff speeds, V1, VR, and V2 are read from either the wet or dry table by entering with takeoff flap setting and brake release weight. Use the tables provided to correct takeoff speeds for altitude and actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind corrections to V1 are obtained by entering the Slope and Wind V1 Adjustment Table.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Brakes Deactivated

When operating with brakes deactivated, the field limit weight and the V1 must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway limited weight by 8400 lb for a dry runway or 5000 lb for a wet runway and the V1 associated with the reduced weight by 2 knots. With two brakes deactivated, reduce the normal runway limited weight by 17000 lb for a dry runway or 10400 lb for a wet runway and the V1 associated with the reduced weight by 5 knots for a dry runway or 3 knots for a wet runway. If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the dry accelerate stop distance corrected for wind and slope exceeds approximately 4900 ft for one brake deactivated or 5100 ft for two brakes deactivated. For wet runways, the corrected accelerate stop distance should exceed approximately 6200 ft for one brake deactivated or 6400 ft for two brakes deactivated.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

One Thrust Reverser Inoperative

Wet runway takeoff performance presented for all brakes operating is based on the use of one thrust reverser during deceleration. When operating with a thrust reverser inoperative, the runway/obstacle limited takeoff weight and V1 speed must be reduced to account for the reduced deceleration capability. A simplified method which conservatively accounts for this is to reduce the normal wet runway/obstacle limited weight by 11800 lb and the V1 associated with the reduced weight by 3 knots.

If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate stop distance available corrected for wind and slope exceeds approximately 6300 ft.

Enroute

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination. Data is based on economy climb and descent speeds, and Long Range Cruise with normal engine bleed for air conditioning. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine trip fuel and time for a constant altitude cruise, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time Table with air distance from the Ground to Air Miles Conversion Table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment Table with the Reference Fuel and the planned landing weight to obtain fuel required at the planned landing weight.

Long Range Cruise Step Climb Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination when flying a step climb profile. Step climb profiles are based on 4000 ft step climbs to keep the flight within 2000 ft of the optimum altitude for the current cruise weight. To determine trip fuel and time, enter the Ground to Air Miles Conversion table and determine air distance

as discussed above. Then enter the Trip Fuel and Time required with air distance and planned landing weight to read trip fuel. Continue across the table to read trip time.

Short Trip Fuel and Time

These tables are provided to determine trip fuel and time for short distances or alternates. The data considers the use of the FMC short trip optimum altitude. Obtain air distance from upper table using the ground distance and wind component to the alternate. Enter Trip Fuel and Time table with air distance and read trip fuel required for the expected landing weight, together with time to alternate at right. For distances greater than shown or other altitudes, use the Long Range Cruise Trip Fuel and Time tables.

Holding Planning

These tables provide total fuel flow information necessary for planning Flaps Up and Flaps 1 holding and reserve fuel requirements. Data is based on the FMC holding speed schedule which is the higher of the maximum endurance and flaps up maneuver speeds. As noted, the fuel flow is based on flight in a racetrack holding pattern. For holding in straight and level flight, reduce table values by 5%.

Oxygen Requirements

Flight Crew System

Regulations require that sufficient oxygen be provided to the flight crew to account for the greater of supplemental breathing oxygen in the event of a cabin depressurization or protective breathing in the event of smoke or harmful fumes in the flight deck. The oxygen quantity associated with these requirements is achieved with the minimum dispatch oxygen cylinder pressure. Enter the Crew Oxygen Requirements table with the number of crew plus observers using oxygen and read the minimum cylinder pressure required for the appropriate bottle temperature.

An additional quantity of oxygen is required when flight altitudes above 41000 ft are planned. Regulations require that one active duty pilot must don the oxygen mask and breathe diluted oxygen for the duration of the flight above 41000 ft. The additional quantity of oxygen required is 2.05 liters/person/minute (1.2 psi/person/minute for the single cylinder system), or 13 liters/person/minute (8 psi/person/minute) if 100% oxygen is selected during normal usage.

Net Level Off Weight

The Net Level Off Weight table is provided to determine terrain clearance capability in straight and level flight following an engine failure.

Regulations require terrain clearance planning based on net performance which is the gross (or actual) gradient performance degraded by 1.1%. In addition, the net level off pressure altitude must clear the terrain by 1000 ft.

To determine the maximum weight for terrain clearance, enter the table with required net level off pressure altitude and expected ISA deviation to obtain weight. Adjust weight for anti-ice operation as noted below the table.

Extended Range Operations

Regulations require that flights conducted over a route that contains a point further than one hour's time at "normal one engine inoperative speed" from an adequate diversion airport comply with rules set up specifically for "Extended Range Operation with Two Engine airplanes". This section provides reserve fuel planning information for the "Critical Fuel Scenario" based on two engine operation at Long Range Cruise as well as single engine operation at Long Range Cruise.

Critical Fuel Reserves

Enter Ground to Air Mile Conversion table with forecast wind and ground distance to diversion airport from critical point to obtain air distance. Now enter Critical Fuel table with air distance and expected weight at the critical point and read required fuel. Apply the noted fuel adjustments as necessary. Regulations require a 5% allowance for performance deterioration unless a value has been established by the operator for in-service deterioration.

As noted below each table, the fuel required is the greater of the two engine fuel and the single engine fuel. This fuel is compared to the amount of fuel normally onboard the airplane at that point in the route. If the fuel required by the critical fuel reserves exceeds the amount of fuel normally expected, the fuel load must be adjusted accordingly.

Landing

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for Flaps 30.

Maximum landing weight is the lowest of the field length limit weight, climb limit weight or maximum certified landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required.

Go-Around Climb Gradient

Enter the Reference Go-around Gradient table with airport OAT and pressure altitude to determine the reference Go-Around Gradient. Then adjust the reference gradient for airplane weight and speed using the tables provided to determine the weight and speed adjusted Go-Around Gradient. Apply the necessary engine bleed corrections as noted. Note that data is for one engine inoperative.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted adjustments as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent takeoff, or ensure the brake temperature is within limits using the alternate procedure described on the page.

Gear Down

This section provides flight planning data for revenue operation with gear down.

Takeoff/Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to determine Takeoff Climb Limit Weight with gear down. Correct the weight obtained for engine bleed configuration as required.

The remaining gear down tables in this section are identical in format and usage to the corresponding gear up tables previously described.

Intentionally
Blank

Performance Inflight

Chapter PI

Table of Contents

777-200 GE90-76B KG JAA	----- PI.10.1
777-200ER TRENT892 KG FAA	----- PI.20.1
777-200LR GE90-110B1L KG FAA	----- PI.30.1
777F GE90-110B1L KG JAA	----- PI.40.1
777-300 PW4090 LB FAA	----- PI.50.1
777-300ER GE90-115BL LB FAA	----- PI.60.1

Intentionally
Blank

Performance Inflight**Chapter PI****Table of Contents****Section 10****777-200 GE90-76B KG JAA**

General	PI.10.1
Maximum Allowable Clearway	PI.10.1
Clearway and Stopway V1 Adjustments	PI.10.1
VREF	PI.10.2
Flap Maneuver Speed	PI.10.3
Slush/Standing Water Takeoff	PI.10.4
Slippery Runway Takeoff	PI.10.6
Minimum Control Speeds	PI.10.10
Go-around %N1	PI.10.11
Max Climb %N1	PI.10.12
Flight With Unreliable Airspeed / Turbulent Air Penetration	PI.10.13
All Engine	PI.11.1
Long Range Cruise Maximum Operating Altitude	PI.11.1
Long Range Cruise Control	PI.11.2
Long Range Cruise Enroute Fuel and Time - Low Altitude	PI.11.3
Long Range Cruise Enroute Fuel and Time - High Altitude	PI.11.4
Long Range Cruise Wind-Altitude Trade	PI.11.5
Descent at .84M/310/250	PI.11.5
Holding	PI.11.6
Advisory Information	PI.12.1
Normal Configuration Landing Distance	PI.12.1
Non-Normal Configuration Landing Distance	PI.12.4
ANTISKID - Flaps 25	PI.12.4
ANTISKID - Flaps 30	PI.12.5
ENG SHUTDOWN L, R - Flaps 20	PI.12.6
ENG SHUTDOWN L, R - Flaps 30	PI.12.7
FLAP / SLAT CONTROL - Flaps 20	PI.12.8
FLAPS DRIVE - (Flaps ≤ 5)	PI.12.9

FLAPS DRIVE - (5 < Flaps < 20)	PI.12.10
FLAPS DRIVE - (Flaps ≥ 20)	PI.12.11
FLAPS PRIMARY FAIL - Flaps 20	PI.12.12
FLIGHT CONTROL MODE - Flaps 20	PI.12.13
HYD PRESS SYS C - Flaps 20	PI.12.14
HYD PRESS SYS L - Flaps 25	PI.12.15
HYD PRESS SYS L - Flaps 30	PI.12.16
HYD PRESS SYS L+C - Flaps 20	PI.12.17
HYD PRESS SYS L+R - Flaps 20	PI.12.18
HYD PRESS SYS R - Flaps 25	PI.12.19
HYD PRESS SYS R - Flaps 30	PI.12.20
HYD PRESS SYS R+C - Flaps 20	PI.12.21
PITCH UP AUTHORITY - (Flaps ≤ 15).	PI.12.22
PITCH UP AUTHORITY - (Flaps ≥ 20).	PI.12.23
PRIMARY FLIGHT COMPUTERS - Flaps 20	PI.12.24
SLATS DRIVE - Flaps 20	PI.12.25
STABILIZER - Flaps 20	PI.12.26
Landing Climb Limit Weight	PI.12.27
Recommended Brake Cooling Schedule.	PI.12.28

Engine Inoperative PI.13.1

Initial Max Continuous %N1	PI.13.1
Max Continuous %N1.	PI.13.2
Driftdown Speed/Level Off Altitude.	PI.13.5
Driftdown/LRC Cruise Range Capability.	PI.13.6
Long Range Cruise Altitude Capability	PI.13.7
Long Range Cruise Control	PI.13.7
Long Range Cruise Diversion Fuel and Time.	PI.13.8
Holding	PI.13.9
Gear Down Landing Rate of Climb Available	PI.13.10

Gear Down. PI.14.1

Long Range Cruise Altitude Capability	PI.14.1
Long Range Cruise Control	PI.14.1
Long Range Cruise Enroute Fuel and Time	PI.14.2

777 Flight Crew Operations Manual

Descent at VREF30 + 80	PI.14.3
Holding	PI.14.4
Gear Down, Engine Inoperative	PI.15.1
Driftdown Speed/Level Off Altitude	PI.15.1
Long Range Cruise Altitude Capability	PI.15.1
Long Range Cruise Control	PI.15.1
Long Range Cruise Diversion Fuel and Time	PI.15.2
Holding	PI.15.3
Text	PI.16.1
Introduction	PI.16.1
General	PI.16.1
All Engines	PI.16.4
Advisory Information	PI.16.6
Engine Inoperative	PI.16.8
Gear Down	PI.16.11

Intentionally
Blank

Performance Inflight
General

Chapter PI
Section 10

Maximum Allowable Clearway

FIELD LENGTH (M)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (M)
1500	170
2000	220
2500	260
3000	320
3500	360
4000	410
4500	460

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (M)	NORMAL V1 (KIAS)							
	DRY RUNWAY				WET RUNWAY			
	100	120	140	160	100	120	140	160
300	-3	-3	-3	-3	-2	-2	-2	-2
200	-3	-3	-3	-3	-2	-2	-2	-2
100	-2	-2	-2	-2	-2	-2	-2	-2
0	0	0	0	0	0	0	0	0
-100	3	3	2	2	2	2	2	2
-200	5	4	3	3	4	3	3	3
-300	7	6	5	5	6	5	5	5

VREF

WEIGHT (1000 KG)	FLAPS		
	30	25	20
250	151	159	164
240	148	156	161
230	145	152	158
220	142	149	154
210	139	145	150
200	135	142	147
190	132	138	143
180	128	134	139
170	124	131	135
160	121	127	131
150	117	123	127
140	113	118	123

Flap Maneuver Speed

FLAP POSITION	MANEUVER SPEED
FLAPS 0	VREF30 + 80
FLAPS 1	VREF30 + 60
FLAPS 5	VREF30 + 40
FLAPS 15	VREF30 + 20
FLAPS 20	VREF30 + 20
FLAPS 25	VREF25
FLAPS 30	VREF30

ADVISORY INFORMATION

Slush/Standing Water Takeoff

Maximum Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	-40.2	-44.2	-48.2	-46.7	-50.7	-54.7	-60.5	-64.5	-68.5
300	-36.8	-40.7	-44.7	-42.6	-46.6	-50.5	-54.8	-58.7	-62.7
280	-33.3	-37.3	-41.3	-38.4	-42.4	-46.4	-49.0	-53.0	-57.0
260	-29.8	-33.8	-37.8	-34.2	-38.2	-42.2	-43.3	-47.3	-51.3
240	-26.4	-30.4	-34.4	-30.0	-34.0	-38.0	-37.5	-41.5	-45.5
220	-22.9	-26.9	-30.9	-25.9	-29.8	-33.8	-31.8	-35.8	-39.8
200	-19.5	-23.5	-27.5	-21.7	-25.7	-29.7	-26.1	-30.0	-34.0
180	-16.0	-20.0	-24.0	-17.5	-21.5	-25.5	-20.3	-24.3	-28.3

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2200							162		
2400	159			175			201		
2600	200			217			241	159	
2800	242	156		258	172		281	199	
3000	283	197		299	214			238	156
3200		239	153		255	169		278	196
3400		280	194		296	211			235
3600			236			252			275
3800			277			293			

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -50 m/+45 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
260	-20	-20	-20	-14	-14	-14	-2	-2	-2
240	-22	-22	-22	-17	-17	-17	-6	-6	-6
220	-24	-24	-24	-20	-20	-20	-10	-10	-10
200	-26	-26	-26	-22	-22	-22	-14	-14	-14
180	-27	-27	-27	-24	-24	-24	-18	-18	-18

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION**Slush/Standing Water Takeoff****No Reverse Thrust****Weight Adjustment (1000 KG)**

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	-53.7	-57.9	-62.1	-61.4	-65.6	-69.8	-80.6	-84.7	-88.9
300	-49.4	-53.5	-57.7	-56.0	-60.2	-64.3	-71.7	-75.8	-80.0
280	-45.0	-49.2	-53.4	-50.6	-54.8	-59.0	-63.0	-67.2	-71.3
260	-40.8	-44.9	-49.1	-45.3	-49.5	-53.7	-55.0	-59.1	-63.3
240	-36.6	-40.8	-44.9	-40.2	-44.4	-48.5	-47.6	-51.7	-55.9
220	-32.5	-36.7	-40.9	-35.2	-39.3	-43.5	-40.8	-45.0	-49.1
200	-28.6	-32.7	-36.9	-30.2	-34.4	-38.6	-34.7	-38.8	-43.0
180	-24.7	-28.8	-33.0	-25.5	-29.6	-33.8	-29.1	-33.3	-37.5

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
3000							147.9		
3200							198.4		
3400							252.7		
3600	145.7			217.1			312.0	163.7	
3800	210.4			285.5				215.2	
4000	281.9			345.2	161.9			270.9	
4200		166.5			240.2			332.0	179.7
4400		231.8			305.0				232.4
4600		308.5				188.8			289.7
4800			186.9			261.9			352.0
5000			254.2			323.8			
5200			338.5						

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -75 m/+70 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
260	-34	-32	-30	-26	-24	-22	-6	-4	-2
240	-37	-35	-33	-30	-28	-26	-13	-11	-9
220	-40	-38	-36	-35	-33	-31	-20	-18	-16
200	-44	-42	-40	-39	-37	-35	-28	-26	-24
180	-47	-45	-43	-44	-42	-40	-35	-33	-31

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slippery Runway Takeoff Maximum Reverse Thrust Weight Adjustments (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	0.0	-0.7	-2.0	-13.9	-15.1	-16.4	-33.0	-34.2	-35.5
300	0.0	-1.2	-2.4	-15.4	-16.7	-18.0	-32.6	-33.9	-35.1
280	-0.3	-1.6	-2.9	-17.0	-18.2	-19.5	-32.2	-33.5	-34.7
260	-1.6	-2.9	-4.2	-17.9	-19.2	-20.5	-31.3	-32.6	-33.9
240	-3.1	-4.4	-5.6	-18.1	-19.3	-20.6	-29.8	-31.1	-32.3
220	-3.8	-5.0	-6.3	-17.3	-18.6	-19.9	-27.6	-28.8	-30.1
200	-3.7	-5.0	-6.2	-15.7	-17.0	-18.3	-24.6	-25.9	-27.2
180	-2.9	-4.1	-5.4	-13.3	-14.6	-15.8	-21.1	-22.3	-23.6

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1600	158								
1800	233	156							
2000	307	230	153						
2200		305	228	170					
2400			302	228					
2600				285	201				
2800					258	175			
3000					316	232	181		
3200						289	221		
3400							260	176	
3600							300	216	
3800								255	171
4000								295	210
4200									250
4400									289

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -25 m/+20 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -40 m/+35 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -55 m/+50 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
V1 Adjustments (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
260	-6	-4	-2	-17	-15	-13	-30	-28	-26
240	-8	-6	-4	-19	-17	-15	-34	-32	-30
220	-9	-7	-5	-22	-20	-18	-38	-36	-34
200	-10	-8	-6	-24	-22	-20	-42	-40	-38
180	-11	-9	-7	-26	-24	-22	-45	-43	-41

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slippery Runway Takeoff

No Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	0.0	0.0	-0.7	-25.6	-26.4	-27.1	-48.8	-49.5	-50.2
300	-3.2	-3.9	-4.7	-27.5	-28.2	-28.9	-47.8	-48.5	-49.2
280	-6.3	-7.1	-7.8	-28.5	-29.3	-30.0	-46.0	-46.8	-47.5
260	-8.7	-9.4	-10.1	-28.8	-29.5	-30.2	-43.6	-44.3	-45.1
240	-10.2	-10.9	-11.6	-28.2	-28.9	-29.7	-40.5	-41.2	-41.9
220	-10.8	-11.6	-12.3	-26.9	-27.6	-28.3	-36.6	-37.4	-38.1
200	-10.7	-11.4	-12.2	-24.7	-25.4	-26.1	-32.1	-32.8	-33.5
180	-9.8	-10.5	-11.2	-21.7	-22.5	-23.2	-26.8	-27.5	-28.3
160	-8.0	-8.7	-9.4	-18.0	-18.7	-19.4	-20.8	-21.5	-22.3

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2000	238.5								
2200	333.2	241.5							
2400		335.1	244.5						
2600			337.1						
3000				243.8					
3200				351.8					
3400					295.1				
3600						216.5			
3800						335.8			
4800							285.5		
5400								304.1	
6000									319.9

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -30 m/+30 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -45 m/+40 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -80 m/+75 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
260	-10	-8	-6	-26	-24	-22	-51	-49	-47
240	-12	-10	-8	-30	-28	-26	-58	-56	-54
220	-15	-13	-11	-34	-32	-30	-65	-63	-61
200	-17	-15	-13	-39	-37	-35	-74	-72	-70
180	-20	-18	-16	-45	-43	-41	-84	-82	-80
160	-22	-20	-18	-50	-48	-46	-95	-93	-91

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

Minimum Control Speeds

V1(MCG)

Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
60	140	107	103	102	100		
50	122	110	107	103	100	99	97
40	104	115	113	110	105	101	97
30	86	117	117	116	111	107	103
20	68	117	117	116	115	112	107
-60	-76	118	118	117	116	113	110

Go-around %N1**Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off**

REPORTED OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)											
°F	°C	°C	-2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
133	56	60	91.5	91.4	91.6	91.8	91.6	91.4	91.1	90.9	90.8	90.5	90.2	90.0
124	51	55	93.2	93.7	93.5	93.4	93.37	93.1	92.7	92.6	92.4	92.1	91.9	91.6
115	46	50	94.3	95.4	95.5	95.6	95.2	94.8	94.3	94.2	94.1	93.8	93.5	93.3
106	41	45	95.4	97.0	97.1	97.2	96.9	96.7	96.3	95.9	95.6	95.3	95.1	94.8
97	36	40	96.0	98.2	98.6	98.7	98.3	98.1	97.8	97.7	97.6	97.1	96.7	96.4
88	31	35	95.2	98.3	99.2	99.7	99.6	99.5	99.2	99.0	98.9	98.6	98.6	98.4
79	26	30	94.4	97.5	98.6	99.6	100.4	100.4	100.4	100.3	100.1	99.9	99.6	99.6
70	21	25	93.6	96.7	97.7	98.8	99.8	100.9	101.2	101.2	101.1	101.0	100.7	100.4
61	16	20	92.8	95.9	96.9	98.0	98.9	100.0	100.7	101.4	101.9	101.8	101.5	101.3
52	11	15	92.0	95.0	96.0	97.1	98.1	99.2	99.9	100.5	101.1	101.7	102.1	102.1
45	7	10	91.2	94.2	95.2	96.3	97.2	98.3	99.0	99.6	100.2	100.9	101.3	101.7
36	2	5	90.4	93.4	94.4	95.4	96.4	97.4	98.1	98.7	99.3	100.0	100.4	100.8
27	-3	0	89.6	92.5	93.5	94.6	95.5	96.5	97.2	97.8	98.5	99.1	99.5	99.9
9	-13	-10	88.0	90.8	91.8	92.8	93.7	94.8	95.4	96.0	96.6	97.2	97.6	98.0
-9	-23	-20	86.3	89.1	90.1	91.0	91.9	92.9	93.6	94.2	94.8	95.4	95.7	96.1
-27	-33	-30	84.6	87.3	88.3	89.2	90.1	91.1	91.7	92.3	92.9	93.5	93.8	94.2
-45	-43	-40	82.8	85.5	86.4	87.4	88.2	89.2	89.8	90.4	91.0	91.5	91.9	92.3
-63	-53	-50	81.0	83.6	84.6	85.5	86.3	87.3	87.9	88.4	89.0	89.5	89.9	90.3

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)											
	-2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
PACKS OFF	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4
1 PACK ON	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.4	-0.4
WING ANTI-ICE ON	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2

Max Climb %N1

Based on engine bleed for packs on or off and anti-ice off

TAT		PRESSURE ALTITUDE (FT)/ SPEED (IAS/MACH)									
		0	5000	10000	15000	20000	25000	30000	35000	40000	43000
°C	°F	310(0.47)	310(0.51)	310(0.56)	310(0.61)	310(0.67)	310(0.74)	310(0.81)	(0.84)	(0.84)	(0.84)
60	140	86.5	87.9	89.4	91.3	93.9	96.3	99.7	103.2	103.1	102.5
50	122	88.7	88.8	89.2	89.9	92.5	94.8	98.2	101.6	101.5	100.9
40	104	90.0	90.5	90.7	90.8	91.3	93.3	96.7	100.1	99.9	99.3
30	86	89.1	93.2	92.9	92.8	93.1	93.6	95.2	98.4	98.3	97.7
20	68	87.6	91.6	93.9	94.6	94.8	95.2	96.5	97.2	96.7	96.1
15	59	86.9	90.8	93.1	95.3	95.5	95.9	97.0	97.8	97.0	96.4
10	50	86.1	90.0	92.3	94.5	96.2	96.5	97.6	98.4	97.6	97.1
5	41	85.4	89.2	91.5	93.7	95.8	97.2	98.2	99.0	98.2	97.7
0	32	84.6	88.4	90.7	92.8	94.9	97.0	98.9	99.6	98.9	98.4
-5	23	83.8	87.6	89.8	92.0	94.1	96.1	98.9	100.4	99.6	99.0
-10	14	83.0	86.8	89.0	91.1	93.2	95.2	98.0	101.6	100.5	99.9
-15	5	82.2	86.0	88.1	90.2	92.3	94.3	97.1	101.5	101.4	100.8
-20	-4	81.4	85.1	87.3	89.4	91.4	93.3	96.1	100.5	100.4	99.9
-25	-13	80.6	84.3	86.4	88.5	90.5	92.4	95.2	99.5	99.4	98.9
-30	-22	79.8	83.4	85.5	87.6	89.6	91.5	94.2	98.5	98.4	97.9
-35	-31	79.0	82.6	84.6	86.7	88.6	90.5	93.2	97.5	97.4	96.9
-40	-40	78.2	81.7	83.8	85.8	87.7	89.6	92.3	96.5	96.4	95.8

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)					
	0	10	20	30	40	43
2 PACKS ON - 1 BLEED SOURCE	-0.5	-0.6	-0.8	-0.8	-1.2	-1.4
1 PACK ON - 1 BLEED SOURCE	-0.5	-0.6	-0.8	-0.8	-1.2	-1.4
1 PACK ON - 2 BLEED SOURCES	-0.5	-0.6	-0.8	-0.8	-1.2	-1.4
ENGINE ANTI-ICE ON	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4
ENGINE AND WING ANTI-ICE ON*	-0.5	-0.5	-0.5	-0.9	-1.1	-1.4
ENGINE AND WING ANTI-ICE ON**	-0.6	-0.7	-0.7	-1.4	-1.9	-2.3

*Wing anti-ice on, packs on, or packs off with 2 bleed sources.

**Wing anti-ice on, packs off, 1 bleed source.

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb**Flaps Up, Set Max Climb Thrust**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82M)	PITCH ATT	3.5	3.5		
	V/S (FT/MIN)	1300	600		
30000 (280 KIAS)	PITCH ATT	4.5	4.0	4.0	4.0
	V/S (FT/MIN)	2100	1500	1000	600
20000 (270 KIAS)	PITCH ATT	6.5	6.0	6.0	6.0
	V/S (FT/MIN)	3100	2300	1700	1200
10000 (270 KIAS)	PITCH ATT	9.5	8.5	8.0	7.5
	V/S (FT/MIN)	4200	3200	2500	2000
SEA LEVEL (270 KIAS)	PITCH ATT	11.5	10.0	9.0	9.0
	V/S (FT/MIN)	4700	3700	2900	2300

Cruise**Flaps Up, %N1 for Level Flight**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82M)	PITCH ATT	1.7	2.3		
	%N1	87.5	91.4		
35000 (280 KIAS)	PITCH ATT	1.4	1.9	2.4	
	%N1	84.1	86.7	89.8	
30000 (280 KIAS)	PITCH ATT	1.5	2.1	2.7	3.4
	%N1	79.4	82.2	85.5	89.4
25000 (280 KIAS)	PITCH ATT	1.6	2.2	2.9	3.5
	%N1	75.3	77.8	80.7	84.4
20000 (270 KIAS)	PITCH ATT	1.8	2.5	3.2	4.0
	%N1	70.2	72.9	75.9	79.3
15000 (270 KIAS)	PITCH ATT	1.7	2.5	3.2	4.0
	%N1	65.9	68.4	71.3	74.6

Descent**Flaps Up, Set Idle Thrust**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82M)	PITCH ATT	-1.7	-0.9		
	V/S (FT/MIN)	-2900	-2700		
30000 (280 KIAS)	PITCH ATT	-1.3	-0.4	0.4	1.0
	V/S (FT/MIN)	-2200	-2000	-1900	-1900
20000 (270 KIAS)	PITCH ATT	-1.1	-0.1	0.8	1.6
	V/S (FT/MIN)	-1800	-1600	-1600	-1600
10000 (270 KIAS)	PITCH ATT	-1.4	-0.3	0.7	1.5
	V/S (FT/MIN)	-1700	-1500	-1400	-1400
SEA LEVEL (270 KIAS)	PITCH ATT	-1.4	-0.3	0.7	1.5
	V/S (FT/MIN)	-1400	-1200	-1200	-1200

Flight With Unreliable Airspeed / Turbulent Air Penetration
Altitude and/or vertical speed indications may also be unreliable.

Holding

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)			
		160	200	240	280
10000	PITCH ATT	4.0	4.5	5.0	5.0
	%N1	55.1	60.4	65.1	69.6
	KIAS	202	216	230	247
5000	PITCH ATT	4.0	4.5	5.0	5.0
	%N1	52.0	57.0	61.5	65.8
	KIAS	202	216	230	246

Terminal Area (5000 FT)

%N1 for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)			
		160	200	240	280
FLAPS UP GEAR UP (VREF 30 + 80)	PITCH ATT	4.5	5.0	5.5	5.5
	%N1	52.7	58.3	63.1	67.5
	KIAS	201	216	229	241
FLAPS 1 GEAR UP (VREF 30 + 60)	PITCH ATT	6.0	6.5	7.0	7.5
	%N1	53.1	58.7	64.1	68.6
	KIAS	181	196	209	221
FLAPS 5 GEAR UP (VREF 30 + 40)	PITCH ATT	5.0	5.5	5.5	6.0
	%N1	54.3	60.2	65.4	70.0
	KIAS	161	176	189	201
FLAPS 15 GEAR UP (VREF 30 + 20)	PITCH ATT	6.0	6.0	6.5	6.5
	%N1	55.1	61.6	67.1	72.0
	KIAS	141	156	169	181
FLAPS 20 GEAR DOWN (VREF 30 + 20)	PITCH ATT	4.0	4.5	5.0	5.0
	%N1	61.6	68.3	73.9	78.9
	KIAS	141	156	169	181

Final Approach (1500 FT)

Gear Down, %N1 for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)			
		160	200	240	280
FLAPS 20 (VREF 20 + 10)	PITCH ATT	1.0	1.5	1.5	1.5
	%N1	41.0	45.8	49.8	53.4
	KIAS	142	157	172	185
FLAPS 25 (VREF 25 + 10)	PITCH ATT	0.0	0.5	0.5	0.5
	%N1	49.9	55.0	59.6	63.9
	KIAS	138	153	166	179
FLAPS 30 (VREF 30 + 10)	PITCH ATT	-0.5	0.0	0.0	0.0
	%N1	55.1	60.7	65.8	70.3
	KIAS	131	146	159	171

Performance Inflight

All Engine

Chapter PI

Section 11

Long Range Cruise Maximum Operating Altitude

Max Climb Thrust

ISA + 10°C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30500	-2	33000*	32600	31100
290	31200	-3	34100*	33300	31800
280	32000	-5	35100*	34000	32600
270	32800	-7	35900*	34800	33300
260	33600	-9	36500*	35600	34200
250	34400	-11	37300*	36400	35000
240	35300	-12	38200*	37300	35800
230	36200	-14	39000*	38100	36700
220	37100	-14	39900*	39100	37600
210	38100	-14	40800*	40000	38600
200	39100	-14	41800*	41100	39600
190	40100	-14	42800*	42100	40700
180	41300	-14	43000	43000	41800
170	42500	-14	43000	43000	43000
160	43000	-14	43000	43000	43000
150	43000	-14	43000	43000	43000
140	43000	-14	43000	43000	43000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30500	4	31400*	31400*	31100
290	31200	2	32700*	32700*	31800
280	32000	1	33900*	33900*	32600
270	32800	-1	35100*	34800	33300
260	33600	-3	35900*	35600	34200
250	34400	-5	36500*	36400	35000
240	35300	-7	37400*	37300	35800
230	36200	-9	38300*	38100	36700
220	37100	-9	39200*	39100	37600
210	38100	-9	40000*	40000	38600
200	39100	-9	40900*	40900*	39600
190	40100	-9	41900*	41900*	40700
180	41300	-9	42900*	42900*	41800
170	42500	-9	43000	43000	43000
160	43000	-9	43000	43000	43000
150	43000	-9	43000	43000	43000
140	43000	-9	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30500	10	26100*	26100*	26100*
290	31200	8	27600*	27600*	27600*
280	32000	6	31700*	31700*	31700*
270	32800	5	33400*	33400*	33300
260	33600	3	34900*	34900*	34200
250	34400	1	35800*	35800*	35000
240	35300	-1	36400*	36400*	35800
230	36200	-3	37300*	37300*	36700
220	37100	-3	38200*	38200*	37600
210	38100	-3	39200*	39200*	38600
200	39100	-3	40000*	40000*	39600
190	40100	-3	41000*	41000*	40700
180	41300	-3	42000*	42000*	41800
170	42500	-3	43000	43000	43000
160	43000	-3	43000	43000	43000
150	43000	-3	43000	43000	43000
140	43000	-3	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		25	27	29	31	33	35	37	39	41	43
260	%N1	84.9	86.6	88.2	89.5	90.7	92.4				
	MACH	.760	.787	.814	.837	.844	.842				
	KIAS	319	318	316	313	302	288				
	FF/ENG	3910	3893	3902	3902	3847	3842				
240	%N1	82.8	84.5	86.2	87.8	89.1	90.3	92.5			
	MACH	.737	.763	.790	.817	.839	.844	.841			
	KIAS	309	307	306	304	300	288	275			
	FF/ENG	3598	3573	3565	3582	3582	3525	3547			
220	%N1	80.6	82.3	84.0	85.7	87.3	88.6	90.2	92.9		
	MACH	.711	.737	.763	.791	.819	.840	.843	.841		
	KIAS	297	296	295	294	292	287	276	262		
	FF/ENG	3287	3336	3249	3251	3273	3264	3223	3283		
200	%N1	78.1	79.9	81.6	83.3	85.0	86.6	88.3	90.4	93.1	
	MACH	.680	.708	.735	.762	.791	.818	.840	.843	.841	
	KIAS	284	284	283	282	281	279	274	263	250	
	FF/ENG	3035	3030	2949	2939	2950	2965	2964	2952	3013	
180	%N1	75.6	77.2	79.0	80.7	82.4	84.1	86.1	88.3	90.3	92.9
	MACH	.650	.675	.703	.731	.758	.787	.816	.839	.844	.841
	KIAS	270	270	270	270	268	267	265	261	251	239
	FF/ENG	2732	2714	2709	2641	2632	2645	2671	2699	2683	2731
160	%N1	72.9	74.4	76.0	77.8	79.6	81.3	83.3	85.9	88.0	90.0
	MACH	.620	.643	.666	.695	.724	.751	.780	.810	.835	.844
	KIAS	257	256	255	255	255	254	253	251	248	240
	FF/ENG	2447	2422	2397	2341	2335	2328	2358	2406	2429	2419

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitude

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
282	262	243	227	213	200	191	182	174	167	161
564	522	485	453	425	400	382	366	351	337	324
846	783	727	679	638	600	574	549	527	506	487
1130	1045	970	906	850	800	765	733	703	675	650
1414	1308	1214	1133	1063	1000	957	916	879	844	813
1699	1572	1458	1361	1276	1200	1148	1099	1054	1013	976
1986	1836	1703	1589	1489	1400	1339	1282	1230	1182	1138
2273	2101	1947	1816	1702	1600	1530	1465	1405	1350	1300
2561	2366	2192	2044	1916	1800	1721	1648	1580	1518	1462
2850	2632	2438	2273	2129	2000	1912	1830	1755	1686	1624

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME
	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)
200	3.7	0:37	3.3	0:36	2.7	0:35	2.5	0:34	2.1	0:33
400	7.5	1:13	6.9	1:10	6.0	1:06	5.6	1:03	5.0	1:00
600	11.3	1:48	10.5	1:43	9.3	1:36	8.7	1:32	7.8	1:28
800	15.1	2:24	14.1	2:17	12.6	2:07	11.8	2:01	10.7	1:55
1000	18.9	2:59	17.7	2:50	15.9	2:38	14.9	2:30	13.5	2:23
1200	22.6	3:35	21.3	3:25	19.1	3:09	17.9	2:60	16.3	2:50
1400	26.4	4:11	24.8	3:59	22.3	3:41	20.9	3:29	19.1	3:18
1600	30.1	4:47	28.3	4:33	25.5	4:12	23.9	3:59	21.9	3:46
1800	33.8	5:24	31.8	5:08	28.7	4:44	26.9	4:29	24.6	4:14
2000	37.5	6:01	35.2	5:43	31.8	5:16	29.9	4:60	27.4	4:42

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)						
	140	160	180	200	220	240	260
5	-0.8	-0.5	-0.3	-0.3	0.0	0.2	0.4
10	-1.6	-1.1	-0.7	-0.4	0.0	0.5	1.0
15	-2.5	-1.8	-1.0	-0.5	0.0	0.8	1.6
20	-3.3	-2.4	-1.4	-0.7	0.0	1.1	2.2
25	-4.2	-3.1	-1.8	-0.8	0.0	1.3	2.7
30	-5.1	-3.7	-2.3	-1.0	0.0	1.6	3.2
35	-6.0	-4.4	-2.7	-1.2	0.0	1.8	3.7
40	-6.9	-5.1	-3.2	-1.4	0.0	1.9	4.2
45	-7.9	-5.8	-3.7	-1.7	0.0	2.1	4.6
50	-8.8	-6.6	-4.2	-1.9	0.0	2.2	5.0
55	-9.8	-7.3	-4.7	-2.2	0.0	2.3	5.4
60	-10.8	-8.1	-5.3	-2.5	0.0	2.4	5.7

Long Range Cruise Enroute Fuel and Time - High Altitude
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
526	494	465	441	420	400	383	367	353	340	328
1040	981	928	881	839	800	767	737	709	683	659
1556	1470	1391	1321	1258	1200	1152	1107	1065	1026	991
2075	1960	1855	1762	1677	1600	1536	1476	1420	1369	1322
2595	2451	2320	2203	2097	2000	1920	1845	1776	1712	1653
3117	2944	2785	2644	2517	2400	2304	2215	2131	2055	1984
3641	3437	3251	3086	2937	2800	2688	2584	2487	2397	2315
4167	3933	3719	3528	3357	3200	3072	2952	2841	2739	2645
4695	4430	4187	3972	3778	3600	3455	3321	3196	3080	2975
5226	4928	4657	4416	4199	4000	3839	3689	3550	3421	3304
5759	5429	5128	4861	4620	4400	4223	4058	3904	3762	3632
6294	5931	5600	5306	5042	4800	4606	4425	4258	4103	3960
6832	6435	6073	5752	5464	5200	4989	4793	4610	4442	4288
7373	6940	6547	6199	5886	5600	5372	5159	4962	4780	4614
7915	7447	7022	6646	6309	6000	5755	5526	5314	5119	4940
8459	7956	7498	7094	6731	6400	6138	5893	5666	5457	5265
9006	8466	7975	7542	7155	6800	6520	6259	6017	5794	5590
9556	8979	8454	7992	7578	7200	6903	6625	6368	6131	5914
10109	9493	8934	8442	8002	7600	7285	6991	6718	6467	6237
10665	10010	9416	8893	8426	8000	7667	7356	7068	6803	6560

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
400	5.1	0:58	4.9	0:57	4.8	0:57	4.7	0:56	4.6	0:57
800	10.6	1:53	10.2	1:51	10.0	1:49	9.8	1:47	9.6	1:47
1200	16.0	2:48	15.5	2:44	15.2	2:41	14.8	2:38	14.6	2:37
1600	21.5	3:44	20.8	3:38	20.4	3:33	19.9	3:28	19.6	3:26
2000	26.9	4:39	26.1	4:31	25.5	4:25	25.0	4:19	24.5	4:16
2400	32.2	5:35	31.3	5:26	30.5	5:18	29.9	5:11	29.3	5:06
2800	37.6	6:32	36.4	6:21	35.4	6:11	34.7	6:03	34.1	5:57
3200	42.8	7:29	41.5	7:17	40.3	7:05	39.5	6:55	38.7	6:48
3600	47.9	8:28	46.5	8:13	45.0	8:00	44.1	7:48	43.3	7:39
4000	53.0	9:26	51.4	9:10	49.7	8:55	48.7	8:41	47.8	8:30
4400	57.9	10:27	56.2	10:08	54.3	9:51	53.1	9:36	52.2	9:23
4800	62.8	11:28	61.0	11:07	58.8	10:47	57.6	10:30	56.5	10:16
5200	67.6	12:29	65.6	12:06	63.2	11:44	61.9	11:26	60.8	11:09
5600	72.3	13:32	70.2	13:06	67.6	12:42	66.2	12:22	65.0	12:03
6000	77.0	14:34	74.8	14:07	72.0	13:40	70.4	13:18	69.1	12:57
6400	81.5	15:39	79.1	15:09	76.1	14:40	74.5	14:15	73.2	13:52
6800	86.0	16:43	83.5	16:11	80.3	15:40	78.5	15:13	77.2	14:48
7200	90.4	17:49	87.8	17:15	84.5	16:41	82.6	16:11	81.2	15:44
7600	94.7	18:56	92.0	18:19	88.5	17:43	86.5	17:11	85.1	16:41
8000	99.0	20:03	96.2	19:23	92.6	18:44	90.5	18:10	89.0	17:38

Long Range Cruise Enroute Fuel and Time - High Altitude**Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)						
	140	160	180	200	220	240	260
5	-0.6	-0.4	-0.2	-0.1	0.0	0.4	1.3
10	-1.7	-1.2	-0.7	-0.3	0.0	0.8	2.2
15	-2.9	-2.0	-1.2	-0.6	0.0	1.2	3.0
20	-4.0	-2.9	-1.8	-0.8	0.0	1.6	3.8
25	-5.1	-3.7	-2.3	-1.1	0.0	2.0	4.6
30	-6.2	-4.6	-2.9	-1.3	0.0	2.4	5.4
35	-7.4	-5.4	-3.4	-1.6	0.0	2.7	6.1
40	-8.5	-6.2	-4.0	-1.9	0.0	3.1	6.9
45	-9.7	-7.1	-4.5	-2.1	0.0	3.4	7.6
50	-10.8	-8.0	-5.1	-2.4	0.0	3.7	8.2
55	-12.0	-8.8	-5.7	-2.7	0.0	4.0	8.9
60	-13.2	-9.7	-6.3	-3.0	0.0	4.3	9.5
65	-14.3	-10.6	-6.8	-3.3	0.0	4.6	10.1
70	-15.5	-11.5	-7.4	-3.6	0.0	4.9	10.7
75	-16.7	-12.4	-8.0	-3.9	0.0	5.2	11.3
80	-17.9	-13.3	-8.6	-4.2	0.0	5.5	11.8
85	-19.1	-14.2	-9.2	-4.5	0.0	5.7	12.4
90	-20.3	-15.1	-9.8	-4.8	0.0	6.0	12.9
95	-21.5	-16.0	-10.5	-5.1	0.0	6.2	13.3
100	-22.8	-16.9	-11.1	-5.4	0.0	6.4	13.8

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)						
	260	240	220	200	180	160	140
43				37	8	-1	8
41			37	10	0	4	20
39		33	9	0	2	15	35
37	27	8	0	2	12	29	51
35	6	0	2	11	26	45	68
33	-1	2	11	24	41	61	83
31	3	11	23	39	57	77	98
29	13	24	38	54	72	91	111
27	25	38	53	69	87	105	123
25	40	53	68	84	100	117	133

The above wind factor table is for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. Read wind factors for present and new altitudes from table.
2. Determine difference (new altitude wind factor minus present altitude wind factor);
This difference may be negative or positive.
3. Break-even wind at new altitude is present altitude wind plus difference from step 2.

Descent at .84M/310/250

PRESSURE ALTITUDE (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	99	106	112	119	125	130	133	141	147	152
TIME (MINUTES)	20	21	22	22	23	24	24	25	26	27

**Holding
Flaps Up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
260	%N1	61.0	63.8	67.4	72.2	77.2	82.5	87.4	92.0		
	KIAS	236	237	238	240	262	280	284	283		
	FF/ENG	3600	3590	3480	3420	3520	3620	3720	3940		
240	%N1	58.9	61.5	65.1	70.0	74.5	80.1	85.2	89.8		
	KIAS	229	229	229	229	242	269	272	276		
	FF/ENG	3340	3300	3220	3150	3180	3370	3360	3540		
220	%N1	56.8	59.3	62.9	67.6	71.9	77.3	82.7	87.5	94.7	
	KIAS	223	223	223	223	224	247	260	263	252	
	FF/ENG	3080	3030	2960	2880	2880	2990	3030	3160	3510	
200	%N1	54.6	57.0	60.4	65.1	69.1	74.2	79.9	85.0	91.2	
	KIAS	216	216	216	216	216	225	247	250	252	
	FF/ENG	2840	2770	2710	2630	2610	2640	2720	2800	3040	
180	%N1	52.4	54.6	57.8	62.5	66.3	71.1	76.7	82.0	88.4	92.5
	KIAS	209	209	209	209	209	209	227	236	240	235
	FF/ENG	2600	2530	2470	2380	2360	2350	2430	2470	2640	2810
160	%N1	49.9	52.0	55.1	59.8	63.4	68.0	72.8	78.7	85.4	89.3
	KIAS	202	202	202	202	202	202	202	221	225	227
	FF/ENG	2360	2290	2230	2150	2120	2090	2090	2200	2340	2450
140	%N1	47.2	49.3	52.2	56.8	60.3	64.7	69.4	74.6	81.7	85.9
	KIAS	194	194	194	194	194	194	194	199	209	211
	FF/ENG	2130	2070	2010	1920	1890	1840	1850	1860	2000	2090

Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
260	%N1	62.3	65.1	69.0	74.2	78.7
	KIAS	216	216	216	216	216
	FF/ENG	3780	3760	3680	3630	3660
240	%N1	60.1	62.8	66.6	71.8	76.2
	KIAS	209	209	209	209	209
	FF/ENG	3480	3460	3400	3330	3340
220	%N1	57.7	60.4	64.2	69.2	73.6
	KIAS	203	203	203	203	203
	FF/ENG	3190	3160	3120	3040	3040
200	%N1	55.3	57.8	61.6	66.5	70.7
	KIAS	196	196	196	196	196
	FF/ENG	2910	2870	2830	2760	2750
180	%N1	52.7	55.1	58.7	63.6	67.7
	KIAS	189	189	189	189	189
	FF/ENG	2640	2590	2550	2490	2470
160	%N1	50.1	52.2	55.7	60.5	64.5
	KIAS	182	182	182	182	182
	FF/ENG	2370	2320	2280	2220	2200
140	%N1	47.0	49.2	52.4	57.2	61.1
	KIAS	174	174	174	174	174
	FF/ENG	2110	2070	2010	1960	1940

These tables include 5% additional fuel for holding in a racetrack pattern.

Performance Inflight

Advisory Information

Chapter PI

Section 12

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 30

	LANDING DISTANCE AND ADJUSTMENT (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WT	PER 5000 KG ABOVE/ BELOW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF30	ONE REV	NO REV

Dry Runway

MAX MANUAL	880	+25/-5	20	-35/+125	+10/-10	+20/-20	35	15	40
AUTOBRAKE MAX	1180	+20/-5	25	-50/+175	0/0	+30/-30	65	0	0
AUTOBRAKE 4	1455	+25/-10	40	-70/+245	0/-5	+40/-40	80	0	0
AUTOBRAKE 3	1740	+30/-10	45	-90/+305	+10/-10	+50/-50	95	0	0
AUTOBRAKE 2	1935	+40/-20	55	-100/+350	+20/-35	+55/-55	85	20	20
AUTOBRAKE 1	2060	+45/-25	65	-115/+395	+45/-50	+60/-60	90	120	120

Good Reported Braking Action

MAX MANUAL	1390	+25/-10	35	-70/+245	+35/-30	+35/-35	60	80	195
AUTOBRAKE MAX	1485	+30/-10	40	-70/+255	+30/-25	+35/-35	70	85	200
AUTOBRAKE 4	1680	+30/-5	45	-80/+290	+5/-5	+45/-45	90	10	50
AUTOBRAKE 3	2000	+35/-10	50	-105/+350	+10/-10	+60/-60	110	0	0
AUTOBRAKE 2	2225	+45/-25	65	-115/+400	+25/-40	+65/-65	100	25	25
AUTOBRAKE 1	2370	+50/-30	75	-130/+455	+50/-60	+70/-70	105	140	140

Medium Reported Braking Action

MAX MANUAL	1865	+40/-25	60	-110/+395	+80/-70	+45/-45	70	235	610
AUTOBRAKE MAX	1880	+40/-15	60	-110/+400	+80/-65	+45/-50	80	230	605
AUTOBRAKE 4	1910	+40/-15	60	-110/+400	+80/-60	+50/-50	85	235	620
AUTOBRAKE 3	2100	+40/-15	60	-115/+430	+60/-40	+60/-60	110	125	465
AUTOBRAKE 2	2275	+45/-25	65	-125/+455	+60/-60	+65/-65	100	100	345
AUTOBRAKE 1	2400	+50/-30	75	-130/+485	+75/-70	+70/-70	105	185	345

Poor Reported Braking Action

MAX MANUAL	2380	+50/-35	80	-155/+615	+190/-125	+65/-65	80	530	1620
AUTOBRAKE MAX	2385	+60/-35	80	-155/+620	+195/-130	+65/-65	80	535	1625
AUTOBRAKE 4	2405	+60/-35	80	-160/+620	+190/-130	+65/-70	80	535	1640
AUTOBRAKE 3	2440	+50/-30	80	-160/+625	+185/-110	+65/-70	105	510	1620
AUTOBRAKE 2	2535	+60/-35	80	-165/+640	+175/-120	+70/-70	100	430	1520
AUTOBRAKE 1	2600	+60/-35	85	-165/+650	+180/-120	+70/-75	100	465	1455

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 70 m.

For autobrake and manual speedbrakes, increase reference landing distance by 60 m.

Distances for GOOD, MEDIUM, AND POOR are increased by 15%.

Includes distance from 50 ft above threshold (305 meters of unfactored air distance).

ADVISORY INFORMATION**Normal Configuration Landing Distance****Flaps 25**

	LANDING DISTANCE AND ADJUSTMENT (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WT	PER 5000 KG ABOVE/ BELOW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF25	ONE REV	NO REV

Dry Runway

MAX MANUAL	925	+25/-10	20	-35/+130	+10/-10	+20/-20	35	20	45
AUTOBRAKE MAX	1260	+20/-15	30	-55/+180	0/0	+30/-30	65	0	0
AUTOBRAKE 4	1570	+30/-20	40	-75/+255	0/-5	+40/-40	85	0	0
AUTOBRAKE 3	1880	+35/-25	50	-95/+320	+10/-15	+55/-55	95	0	0
AUTOBRAKE 2	2070	+45/-35	60	-105/+365	+30/-45	+60/-60	85	50	50
AUTOBRAKE 1	2190	+50/-40	70	-115/+405	+50/-55	+60/-60	90	170	180

Good Reported Braking Action

MAX MANUAL	1960	+40/-35	60	-110/+410	+85/-70	+50/-50	70	265	695
AUTOBRAKE MAX	1980	+40/-30	60	-110/+410	+85/-65	+50/-50	80	260	685
AUTOBRAKE 4	2025	+40/-30	60	-115/+415	+75/-50	+50/-60	90	245	690
AUTOBRAKE 3	2260	+45/-35	65	-120/+445	+50/-45	+65/-65	110	125	495
AUTOBRAKE 2	2430	+50/-40	75	-130/+470	+65/-70	+70/-70	100	130	395
AUTOBRAKE 1	2545	+60/-45	80	-140/+495	+85/-80	+70/-75	105	240	425

Medium Reported Braking Action

MAX MANUAL	1465	+30/-15	40	-70/+255	+35/-30	+35/-35	60	90	225
AUTOBRAKE MAX	1565	+30/-15	40	-75/+260	+30/-25	+35/-40	70	100	235
AUTOBRAKE 4	1805	+35/-25	45	-85/+300	+5/-5	+45/-45	100	10	50
AUTOBRAKE 3	2160	+40/-30	60	-110/+370	+10/-15	+65/-65	110	0	0
AUTOBRAKE 2	2380	+50/-40	70	-120/+420	+35/-50	+70/-70	100	60	60
AUTOBRAKE 1	2520	+60/-45	80	-130/+465	+60/-65	+70/-70	105	195	205

Poor Reported Braking Action

MAX MANUAL	2495	+60/-45	85	-160/+625	+190/-130	+65/-70	80	585	1835
AUTOBRAKE MAX	2505	+60/-45	85	-160/+625	+195/-130	+65/-70	85	585	1840
AUTOBRAKE 4	2525	+60/-45	85	-160/+635	+190/-130	+65/-70	80	590	1850
AUTOBRAKE 3	2595	+60/-45	85	-165/+640	+180/-115	+70/-75	105	535	1800
AUTOBRAKE 2	2685	+65/-45	85	-165/+650	+180/-125	+70/-75	90	475	1700
AUTOBRAKE 1	2750	+65/-50	90	-175/+660	+185/-125	+75/-80	100	535	1645

Reference distance is for sea level, standard day, no wind or slope, VREF25 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 70 m.

For autobrake and manual speedbrakes, increase reference landing distance by 65 m.

Distances for GOOD, MEDIUM, and POOR are increased by 15%.

Includes distance from 50 ft above threshold (305 meters of unfactored air distance).

ADVISORY INFORMATION**Normal Configuration Landing Distance****Flaps 20**

	LANDING DISTANCE AND ADJUSTMENT (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WT	PER 5000 KG ABOVE/ BELOW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF20	ONE REV	NO REV

Dry Runway

MAX MANUAL	960	+30/-15	20	-40/+130	+10/-10	+20/-20	35	25	50
AUTOBRAKE MAX	1320	+20/-20	30	-55/+185	0/0	+30/-30	65	0	0
AUTOBRAKE 4	1655	+30/-30	45	-75/+260	0/0	+45/-45	90	0	0
AUTOBRAKE 3	2000	+40/-35	55	-95/+330	+5/-15	+55/-55	100	0	0
AUTOBRAKE 2	2200	+45/-45	65	-110/+380	+25/-45	+60/-60	95	50	50
AUTOBRAKE 1	2335	+55/-50	75	-120/+420	+50/-60	+65/-65	95	180	180

Good Reported Braking Action

MAX MANUAL	1540	+30/-25	40	-75/+260	+40/-35	+35/-40	60	110	255
AUTOBRAKE MAX	1635	+30/-30	45	-75/+265	+35/-25	+40/-40	75	110	265
AUTOBRAKE 4	1905	+35/-35	50	-90/+305	+5/-5	+50/-50	105	10	60
AUTOBRAKE 3	2300	+45/-40	65	-110/+380	+5/-15	+65/-65	115	0	0
AUTOBRAKE 2	2530	+50/-50	75	-125/+435	+30/-50	+70/-70	110	60	60
AUTOBRAKE 1	2685	+65/-60	85	-140/+485	+60/-70	+75/-75	110	205	205

Medium Reported Braking Action

MAX MANUAL	2075	+45/-40	65	-115/+420	+90/-75	+50/-60	75	300	805
AUTOBRAKE MAX	2085	+45/-40	65	-115/+420	+90/-70	+50/-60	80	295	795
AUTOBRAKE 4	2135	+45/-40	65	-115/+425	+80/-50	+60/-60	100	280	800
AUTOBRAKE 3	2390	+45/-45	70	-125/+455	+50/-45	+65/-70	115	145	585
AUTOBRAKE 2	2590	+50/-50	80	-140/+490	+65/-70	+75/-75	110	130	455
AUTOBRAKE 1	2710	+65/-60	85	-145/+510	+85/-80	+75/-80	110	255	460

Poor Reported Braking Action

MAX MANUAL	2650	+65/-60	90	-165/+645	+205/-140	+70/-75	85	665	2140
AUTOBRAKE MAX	2655	+65/-60	90	-165/+645	+205/-145	+70/-75	85	665	2145
AUTOBRAKE 4	2675	+65/-60	90	-165/+650	+200/-140	+70/-75	90	675	2150
AUTOBRAKE 3	2750	+65/-60	90	-175/+655	+185/-120	+75/-80	110	615	2110
AUTOBRAKE 2	2860	+65/-60	90	-175/+665	+185/-130	+75/-80	105	530	1990
AUTOBRAKE 1	2920	+70/-65	100	-180/+685	+195/-130	+80/-80	105	580	1910

Reference distance is for sea level, standard day, no wind or slope, VREF20 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 75 m.

For autobrake and manual speedbrakes, increase reference landing distance by 65 m.

Distances for GOOD, MEDIUM, AND POOR are increased by 15%.

Includes distance from 50 ft above threshold (305 meters of unfactored air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

ANTISKID - Flaps 25

VREF25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1705	+40/-30	50	-95/+355	+75/-60	+45/-45	60	230	605
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	1705	+40/-30	50	-95/+355	+75/-60	+45/-45	60	230	605
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	2170	+55/-45	75	-140/+545	+165/-115	+55/-60	70	510	1595
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	2930	+85/-70	110	-235/+1045	+1350/-260	+75/-85	80	1790	5000
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****ANTISKID - Flaps 30****VREF30**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1620	+35/-20	50	-95/+345	+70/-60	+40/-40	60	205	530
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	1620	+35/-20	50	-95/+345	+70/-60	+40/-40	60	205	530
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	2070	+50/-30	70	-135/+535	+165/-110	+55/-55	70	460	1410
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	2805	+80/-55	100	-230/+1035	+1310/-255	+70/-85	80	1675	5000
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

ENG SHUTDOWN L, R - Flaps 20

VREF20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	970	+35/-15	20	-40/+135	+15/-10	+20/-20	35	0	25
AUTOBRAKE MAX	1320	+25/-20	30	-55/+185	0/0	+30/-30	65	0	0
AUTOBRAKE 2	2240	+50/-45	65	-110/+385	+10/-10	+65/-65	125	0	0

Good Reported Braking Action

MAX MANUAL	1400	+30/-25	35	-65/+235	+40/-35	+35/-35	55	0	120
AUTOBRAKE MAX	1490	+30/-30	40	-70/+245	+35/-30	+35/-40	65	0	125
AUTOBRAKE 2	2240	+50/-45	65	-110/+385	+10/-10	+65/-65	125	0	0

Medium Reported Braking Action

MAX MANUAL	1980	+45/-40	60	-110/+400	+105/-80	+55/-55	75	0	385
AUTOBRAKE MAX	1985	+45/-45	60	-110/+400	+105/-75	+55/-55	85	0	380
AUTOBRAKE 3	2135	+50/-45	65	-115/+415	+80/-50	+60/-60	105	0	310

Poor Reported Braking Action

MAX MANUAL	2665	+70/-65	90	-170/+645	+265/-170	+75/-75	90	0	990
AUTOBRAKE MAX	2675	+70/-65	90	-170/+645	+270/-175	+75/-80	90	0	995
AUTOBRAKE 3	2705	+70/-65	90	-170/+645	+270/-170	+75/-80	95	0	1005

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****ENG SHUTDOWN L, R - Flaps 30****VREF30**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	890	+25/-5	20	-35/+125	+10/-10	+20/-20	35	0	20
AUTOBRAKE MAX	1180	+20/-5	25	-50/+175	0/0	+30/-30	65	0	0
AUTOBRAKE 2	1945	+40/-15	55	-105/+355	+10/-10	+55/-55	115	0	0

Good Reported Braking Action

MAX MANUAL	1250	+25/-10	30	-65/+220	+35/-30	+30/-30	55	0	85
AUTOBRAKE MAX	1340	+25/-10	35	-65/+230	+30/-25	+35/-35	65	0	90
AUTOBRAKE 2	1945	+40/-15	55	-105/+355	+10/-10	+55/-55	115	0	0

Medium Reported Braking Action

MAX MANUAL	1750	+40/-20	50	-100/+375	+95/-70	+45/-45	70	0	280
AUTOBRAKE MAX	1755	+40/-20	50	-105/+375	+90/-65	+50/-50	80	0	280
AUTOBRAKE 3	1875	+40/-15	55	-105/+390	+75/-45	+50/-50	95	0	235

Poor Reported Braking Action

MAX MANUAL	2335	+60/-35	75	-160/+605	+235/-150	+65/-65	85	0	725
AUTOBRAKE MAX	2340	+60/-35	75	-160/+605	+235/-150	+65/-70	85	0	725
AUTOBRAKE 3	2370	+60/-35	75	-160/+610	+240/-150	+65/-70	85	0	735

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

FLAP / SLAT CONTROL - Flaps 20

VREF20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	955	+30/-15	20	-40/+130	+10/-10	+20/-20	35	20	50
AUTOBRAKE MAX	1320	+25/-20	30	-55/+185	0/0	+30/-30	65	0	0
AUTOBRAKE 2	2180	+50/-50	65	-110/+375	+30/-45	+60/-60	90	60	60

Good Reported Braking Action

MAX MANUAL	1325	+25/-25	35	-65/+220	+30/-30	+30/-30	50	90	215
AUTOBRAKE MAX	1415	+30/-25	35	-65/+230	+25/-20	+35/-35	65	95	220
AUTOBRAKE 2	2180	+50/-50	65	-110/+375	+30/-45	+60/-60	90	60	60

Medium Reported Braking Action

MAX MANUAL	1780	+40/-40	55	-100/+360	+75/-60	+45/-45	65	250	670
AUTOBRAKE MAX	1795	+40/-40	55	-100/+360	+75/-55	+45/-50	70	245	660
AUTOBRAKE 3	2070	+45/-40	60	-110/+395	+45/-40	+55/-60	95	115	470

Poor Reported Braking Action

MAX MANUAL	2270	+60/-55	75	-145/+555	+175/-115	+60/-65	75	555	1765
AUTOBRAKE MAX	2275	+60/-55	80	-145/+555	+175/-120	+60/-65	75	555	1770
AUTOBRAKE 3	2365	+60/-55	75	-145/+565	+155/-105	+65/-65	95	500	1725

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****FLAPS DRIVE - (Flaps ≤ 5)****VREF30+40**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1170	+45/-15	30	-45/+150	+15/-15	+25/-25	40	40	95
AUTOBRAKE MAX	1710	+30/-5	45	-65/+215	0/0	+45/-45	75	0	0
AUTOBRAKE 2	2845	+65/-45	95	-130/+430	+50/-70	+85/-85	95	220	220

Good Reported Braking Action

MAX MANUAL	1585	+30/-15	45	-70/+240	+35/-30	+40/-40	50	135	325
AUTOBRAKE MAX	1780	+30/-10	50	-75/+260	+15/-10	+45/-45	75	85	285
AUTOBRAKE 2	2845	+65/-45	95	-130/+430	+50/-70	+85/-85	95	220	220

Medium Reported Braking Action

MAX MANUAL	2170	+50/-30	70	-110/+390	+85/-70	+60/-60	65	375	1055
AUTOBRAKE MAX	2200	+50/-25	70	-110/+390	+80/-65	+60/-60	75	370	1040
AUTOBRAKE 3	2725	+55/-35	85	-130/+450	+50/-60	+75/-80	105	175	675

Poor Reported Braking Action

MAX MANUAL	2785	+70/-45	100	-155/+600	+195/-135	+75/-80	80	815	2845
AUTOBRAKE MAX	2795	+70/-45	100	-160/+600	+195/-135	+75/-80	80	815	2855
AUTOBRAKE 3	3005	+70/-45	105	-165/+620	+170/-120	+85/-85	100	665	2720

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

FLAPS DRIVE - (5 < Flaps < 20)

VREF30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1020	+35/-5	25	-40/+135	+15/-10	+20/-20	35	25	60
AUTOBRAKE MAX	1430	+25/-5	35	-60/+195	0/0	+35/-35	70	0	0
AUTOBRAKE 2	2425	+55/-30	75	-115/+400	+25/-50	+70/-70	100	60	60

Good Reported Braking Action

MAX MANUAL	1430	+30/-15	40	-65/+230	+35/-30	+35/-35	55	110	260
AUTOBRAKE MAX	1525	+30/-10	40	-70/+240	+30/-20	+40/-40	65	110	270
AUTOBRAKE 2	2425	+55/-30	75	-115/+400	+25/-50	+70/-70	100	60	60

Medium Reported Braking Action

MAX MANUAL	1945	+45/-25	60	-105/+375	+85/-70	+50/-50	70	305	840
AUTOBRAKE MAX	1965	+45/-25	60	-105/+380	+85/-65	+50/-55	70	300	835
AUTOBRAKE 3	2280	+45/-20	65	-115/+415	+40/-40	+65/-65	105	135	610

Poor Reported Braking Action

MAX MANUAL	2495	+65/-40	90	-150/+580	+190/-130	+65/-70	80	675	2250
AUTOBRAKE MAX	2515	+65/-40	90	-150/+585	+195/-135	+65/-70	80	680	2265
AUTOBRAKE 3	2610	+65/-35	90	-155/+590	+170/-110	+70/-75	100	625	2220

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****FLAPS DRIVE - (Flaps ≥ 20)****VREF20**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BWV 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	960	+30/-15	20	-40/+130	+10/-10	+20/-20	35	25	50
AUTOBRAKE MAX	1320	+25/-20	30	-55/+185	0/0	+30/-30	65	0	0
AUTOBRAKE 2	2200	+50/-50	65	-110/+380	+25/-45	+60/-60	95	50	50

Good Reported Braking Action

MAX MANUAL	1340	+25/-25	35	-65/+225	+35/-30	+30/-35	50	95	220
AUTOBRAKE MAX	1420	+30/-25	40	-65/+230	+30/-20	+35/-35	65	95	230
AUTOBRAKE 2	2200	+50/-50	65	-110/+380	+25/-45	+60/-60	95	50	50

Medium Reported Braking Action

MAX MANUAL	1805	+40/-40	55	-100/+365	+80/-65	+45/-50	65	260	700
AUTOBRAKE MAX	1815	+45/-40	55	-100/+365	+80/-60	+45/-50	70	255	690
AUTOBRAKE 3	2080	+45/-40	60	-110/+395	+45/-40	+55/-60	100	125	510

Poor Reported Braking Action

MAX MANUAL	2305	+60/-55	80	-145/+560	+180/-120	+60/-65	75	580	1860
AUTOBRAKE MAX	2310	+60/-55	80	-145/+560	+180/-125	+60/-65	75	580	1865
AUTOBRAKE 3	2390	+60/-55	80	-150/+570	+160/-105	+65/-70	95	535	1835

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

FLAPS PRIMARY FAIL - Flaps 20

VREF20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1080	+30/-15	25	-40/+145	+15/-15	+25/-25	45	30	60
AUTOBRAKE MAX	1320	+25/-20	30	-55/+185	0/0	+30/-30	65	0	0
AUTOBRAKE 2	2245	+50/-50	65	-110/+385	+5/-25	+65/-65	115	10	10

Good Reported Braking Action

MAX MANUAL	1475	+30/-25	40	-70/+240	+35/-35	+35/-35	60	110	265
AUTOBRAKE MAX	1485	+30/-30	40	-70/+240	+35/-30	+35/-35	70	110	265
AUTOBRAKE 2	2245	+50/-50	65	-110/+385	+5/-25	+65/-65	115	10	10

Medium Reported Braking Action

MAX MANUAL	1965	+45/-40	60	-105/+385	+90/-70	+50/-50	75	305	835
AUTOBRAKE MAX	1955	+45/-40	60	-105/+380	+95/-75	+50/-50	80	305	830
AUTOBRAKE 3	2120	+45/-40	60	-110/+405	+55/-35	+60/-60	110	175	710

Poor Reported Braking Action

MAX MANUAL	2480	+65/-60	85	-155/+585	+195/-130	+65/-70	85	660	2200
AUTOBRAKE MAX	2490	+65/-60	85	-155/+585	+200/-140	+65/-70	85	660	2205
AUTOBRAKE 3	2515	+65/-55	85	-155/+590	+190/-120	+65/-70	100	645	2195

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****FLIGHT CONTROL MODE - Flaps 20****VREF20**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1105	+30/-15	25	-45/+145	+15/-15	+25/-25	50	30	70
AUTOBRAKE MAX	1320	+25/-20	30	-55/+185	0/0	+30/-30	65	0	0
AUTOBRAKE 2	2260	+50/-50	65	-115/+385	0/-15	+65/-65	125	0	0

Good Reported Braking Action

MAX MANUAL	1520	+30/-30	40	-70/+245	+40/-35	+35/-35	65	125	300
AUTOBRAKE MAX	1510	+30/-30	40	-70/+245	+35/-30	+40/-40	70	120	290
AUTOBRAKE 2	2260	+50/-50	65	-115/+385	0/-15	+65/-65	125	0	0

Medium Reported Braking Action

MAX MANUAL	2030	+50/-45	65	-110/+390	+95/-75	+50/-55	80	340	945
AUTOBRAKE MAX	2020	+50/-45	65	-110/+390	+100/-80	+55/-55	85	335	940
AUTOBRAKE 3	2140	+50/-40	65	-115/+405	+70/-35	+60/-60	110	245	855

Poor Reported Braking Action

MAX MANUAL	2570	+70/-60	90	-155/+600	+210/-140	+65/-70	95	725	2515
AUTOBRAKE MAX	2580	+70/-60	90	-155/+600	+215/-145	+70/-70	95	730	2525
AUTOBRAKE 3	2585	+70/-60	90	-160/+600	+215/-130	+70/-75	105	725	2520

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS C - Flaps 20

VREF20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1080	+30/-15	25	-40/+145	+15/-15	+25/-25	45	30	60
AUTOBRAKE MAX	1320	+25/-20	30	-55/+185	0/0	+30/-30	65	0	0
AUTOBRAKE 2	2245	+50/-50	65	-110/+385	+5/-25	+65/-65	115	10	10

Good Reported Braking Action

MAX MANUAL	1475	+30/-25	40	-70/+240	+35/-35	+35/-35	60	110	265
AUTOBRAKE MAX	1485	+30/-30	40	-70/+240	+35/-30	+35/-35	70	110	265
AUTOBRAKE 2	2245	+50/-50	65	-110/+385	+5/-25	+65/-65	115	10	10

Medium Reported Braking Action

MAX MANUAL	1965	+45/-40	60	-105/+385	+90/-70	+50/-50	75	305	835
AUTOBRAKE MAX	1955	+45/-40	60	-105/+380	+95/-75	+50/-50	80	305	830
AUTOBRAKE 3	2120	+45/-40	60	-110/+405	+55/-35	+60/-60	110	175	710

Poor Reported Braking Action

MAX MANUAL	2480	+65/-60	85	-155/+585	+195/-130	+65/-70	85	660	2200
AUTOBRAKE MAX	2490	+65/-60	85	-155/+585	+200/-140	+65/-70	85	660	2205
AUTOBRAKE 3	2515	+65/-55	85	-155/+590	+190/-120	+65/-70	100	645	2195

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS L - Flaps 25****VREF25**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	990	+30/-10	20	-40/+140	+15/-15	+20/-20	40	0	30
AUTOBRAKE MAX	1260	+25/-15	30	-55/+180	0/0	+30/-30	65	0	0
AUTOBRAKE 2	2135	+45/-30	60	-110/+375	0/-10	+60/-60	125	0	0

Good Reported Braking Action

MAX MANUAL	1435	+30/-20	40	-70/+250	+45/-40	+35/-35	65	0	135
AUTOBRAKE MAX	1495	+30/-20	40	-75/+255	+40/-30	+40/-40	70	0	135
AUTOBRAKE 2	2135	+45/-30	60	-110/+375	0/-10	+60/-60	125	0	0

Medium Reported Braking Action

MAX MANUAL	2065	+45/-35	65	-120/+435	+125/-95	+55/-60	85	0	455
AUTOBRAKE MAX	2070	+45/-35	65	-120/+435	+130/-100	+55/-60	85	0	455
AUTOBRAKE 3	2145	+45/-35	65	-120/+445	+115/-75	+60/-60	105	0	455

Poor Reported Braking Action

MAX MANUAL	2875	+70/-55	100	-195/+765	+380/-215	+80/-85	100	0	1310
AUTOBRAKE MAX	2885	+70/-55	100	-195/+765	+385/-220	+80/-85	100	0	1315
AUTOBRAKE 3	2910	+70/-55	100	-195/+765	+375/-220	+85/-85	100	0	1325

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS L - Flaps 30

VREF30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	945	+25/-5	20	-40/+135	+15/-15	+20/-20	40	0	25
AUTOBRAKE MAX	1180	+20/-5	25	-50/+175	0/0	+30/-30	65	0	0
AUTOBRAKE 2	1970	+40/-10	55	-105/+355	0/-5	+55/-55	120	0	0

Good Reported Braking Action

MAX MANUAL	1365	+25/-10	35	-70/+245	+45/-35	+35/-35	65	0	120
AUTOBRAKE MAX	1410	+25/-10	35	-70/+250	+35/-30	+35/-35	70	0	115
AUTOBRAKE 2	1970	+40/-10	55	-105/+355	0/-5	+55/-55	120	0	0

Medium Reported Braking Action

MAX MANUAL	1965	+45/-20	60	-115/+430	+125/-95	+55/-55	85	0	400
AUTOBRAKE MAX	1965	+45/-20	60	-115/+430	+130/-95	+55/-55	85	0	405
AUTOBRAKE 3	2020	+45/-20	60	-120/+435	+120/-75	+55/-55	95	0	415

Poor Reported Braking Action

MAX MANUAL	2745	+65/-35	95	-190/+750	+375/-210	+75/-80	100	0	1180
AUTOBRAKE MAX	2755	+65/-35	95	-190/+750	+380/-215	+80/-80	100	0	1185
AUTOBRAKE 3	2775	+65/-35	95	-195/+755	+370/-210	+80/-80	105	0	1190

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS L+C - Flaps 20****VREF30+20**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1245	+30/-5	30	-50/+165	+20/-20	+30/-30	55	0	50
AUTOBRAKE MAX	1430	+25/-5	35	-60/+195	0/0	+35/-35	70	0	0
AUTOBRAKE 2	2485	+50/-10	70	-120/+405	0/0	+75/-75	140	0	0

Good Reported Braking Action

MAX MANUAL	1810	+35/-10	50	-85/+285	+60/-50	+45/-50	80	0	215
AUTOBRAKE MAX	1790	+35/-10	50	-85/+285	+60/-45	+50/-50	90	0	205
AUTOBRAKE 2	2485	+50/-10	70	-120/+405	0/0	+75/-75	140	0	0

Medium Reported Braking Action

MAX MANUAL	2595	+55/-25	85	-140/+495	+170/-125	+75/-75	105	0	710
AUTOBRAKE MAX	2585	+55/-25	85	-140/+495	+175/-135	+75/-75	110	0	705
AUTOBRAKE 3	2610	+55/-25	85	-140/+495	+170/-115	+75/-75	115	0	715

Poor Reported Braking Action

MAX MANUAL	3580	+85/-50	130	-225/+845	+480/-275	+105/-105	125	0	2015
AUTOBRAKE MAX	3590	+85/-50	135	-225/+850	+490/-285	+105/-110	125	0	2020
AUTOBRAKE 3	3595	+85/-50	135	-225/+850	+490/-275	+105/-110	130	0	2020

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS L+R - Flaps 20

VREF30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1360	+25/-5	35	-60/+195	+35/-30	+35/-35	65	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	1925	+35/-10	55	-95/+320	+85/-70	+55/-55	90	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	3140	+55/-15	95	-175/+620	+315/-210	+95/-95	130	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	5265	+80/-15	180	-355/+1355	+1855/-640	+170/-170	170	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS R - Flaps 25****VREF25**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1090	+20/-15	25	-45/+165	+20/-20	+25/-25	50	0	45
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	1435	+30/-20	40	-70/+250	+45/-40	+35/-35	65	0	135
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	2055	+45/-35	65	-120/+435	+125/-95	+55/-55	80	0	445
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	2835	+65/-50	100	-195/+755	+370/-210	+80/-85	95	0	1265
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS R - Flaps 30

VREF30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1035	+20/-5	25	-45/+160	+20/-15	+25/-25	45	0	40
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	1350	+25/-10	35	-70/+240	+40/-35	+35/-35	60	0	115
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	1915	+40/-20	60	-115/+420	+120/-90	+50/-55	80	0	375
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	2640	+60/-35	90	-185/+735	+350/-195	+75/-75	95	0	1065
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS R+C - Flaps 20****VREF30+20**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1550	+25/-5	40	-65/+225	+40/-35	+40/-40	75	0	120
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	1855	+35/-10	55	-85/+295	+65/-55	+50/-50	90	0	235
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	2645	+55/-25	85	-140/+500	+175/-130	+75/-75	110	0	755
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	3630	+85/-50	135	-225/+855	+490/-280	+105/-110	130	0	2100
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

PITCH UP AUTHORITY - (Flaps ≤ 15)

VREF30+40

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1150	+40/-10	25	-45/+150	+15/-15	+25/-25	40	35	75
AUTOBRAKE MAX	1710	+30/-5	45	-65/+215	0/0	+45/-45	75	0	0
AUTOBRAKE 2	2750	+60/-40	90	-125/+420	+60/-65	+80/-80	90	245	265

Good Reported Braking Action

MAX MANUAL	1575	+30/-15	45	-70/+240	+35/-30	+40/-40	50	120	285
AUTOBRAKE MAX	1795	+30/-10	50	-75/+260	+20/-15	+45/-50	75	80	245
AUTOBRAKE 2	2750	+60/-40	90	-125/+420	+60/-65	+80/-80	90	245	265

Medium Reported Braking Action

MAX MANUAL	2135	+45/-30	70	-105/+390	+85/-70	+55/-60	60	325	865
AUTOBRAKE MAX	2210	+50/-30	70	-110/+395	+80/-65	+60/-60	75	325	870
AUTOBRAKE 3	2655	+55/-35	85	-125/+445	+70/-65	+75/-75	85	190	565

Poor Reported Braking Action

MAX MANUAL	2720	+65/-45	95	-155/+595	+190/-130	+75/-75	75	690	2225
AUTOBRAKE MAX	2750	+65/-45	100	-155/+595	+190/-130	+75/-80	80	685	2225
AUTOBRAKE 3	2940	+70/-50	100	-165/+615	+180/-130	+80/-85	85	585	2090

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****PITCH UP AUTHORITY - (Flaps ≥ 20)****VREF30+20**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	990	+35/-5	20	-40/+130	+10/-10	+20/-20	35	25	50
AUTOBRAKE MAX	1430	+25/-5	35	-60/+195	0/0	+35/-35	70	0	0
AUTOBRAKE 2	2320	+55/-35	75	-115/+385	+45/-50	+65/-65	85	130	130

Good Reported Braking Action

MAX MANUAL	1380	+25/-15	35	-65/+225	+30/-30	+35/-35	45	95	220
AUTOBRAKE MAX	1520	+30/-10	40	-70/+240	+20/-15	+40/-40	70	80	215
AUTOBRAKE 2	2320	+55/-35	75	-115/+385	+45/-50	+65/-65	85	130	130

Medium Reported Braking Action

MAX MANUAL	1855	+40/-25	55	-100/+365	+75/-60	+50/-50	60	260	680
AUTOBRAKE MAX	1895	+45/-20	60	-100/+370	+70/-55	+50/-50	70	255	670
AUTOBRAKE 3	2225	+45/-25	65	-115/+410	+55/-50	+60/-65	90	125	440

Poor Reported Braking Action

MAX MANUAL	2365	+60/-40	80	-145/+560	+175/-120	+65/-65	70	565	1775
AUTOBRAKE MAX	2375	+60/-40	80	-145/+565	+175/-120	+65/-65	75	565	1775
AUTOBRAKE 3	2505	+60/-40	85	-150/+575	+160/-110	+70/-70	85	470	1690

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

PRIMARY FLIGHT COMPUTERS - Flaps 20

VREF20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1105	+30/-15	25	-45/+145	+15/-15	+25/-25	50	30	70
AUTOBRAKE MAX	1320	+25/-20	30	-55/+185	0/0	+30/-30	65	0	0
AUTOBRAKE 2	2260	+50/-50	65	-115/+385	0/-15	+65/-65	125	0	0

Good Reported Braking Action

MAX MANUAL	1520	+30/-30	40	-70/+245	+40/-35	+35/-35	65	125	300
AUTOBRAKE MAX	1510	+30/-30	40	-70/+245	+35/-30	+40/-40	70	120	290
AUTOBRAKE 2	2260	+50/-50	65	-115/+385	0/-15	+65/-65	125	0	0

Medium Reported Braking Action

MAX MANUAL	2030	+50/-45	65	-110/+390	+95/-75	+50/-55	80	340	945
AUTOBRAKE MAX	2020	+50/-45	65	-110/+390	+100/-80	+55/-55	85	335	940
AUTOBRAKE 3	2140	+50/-40	65	-115/+405	+70/-35	+60/-60	110	245	855

Poor Reported Braking Action

MAX MANUAL	2570	+70/-60	90	-155/+600	+210/-140	+65/-70	95	725	2515
AUTOBRAKE MAX	2580	+70/-60	90	-155/+600	+215/-145	+70/-70	95	730	2525
AUTOBRAKE 3	2585	+70/-60	90	-160/+600	+215/-130	+70/-75	105	725	2520

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****SLATS DRIVE - Flaps 20****VREF30+30**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1110	+35/-5	25	-40/+145	+15/-15	+25/-25	40	30	70
AUTOBRAKE MAX	1565	+25/-5	40	-60/+205	+5/0	+40/-40	75	0	0
AUTOBRAKE 2	2550	+55/-35	80	-120/+405	+55/-60	+75/-75	90	170	175

Good Reported Braking Action

MAX MANUAL	1545	+30/-15	45	-70/+240	+40/-35	+40/-40	55	120	285
AUTOBRAKE MAX	1670	+30/-10	45	-75/+250	+25/-20	+45/-45	75	115	290
AUTOBRAKE 2	2550	+55/-35	80	-120/+405	+55/-60	+75/-75	90	170	175

Medium Reported Braking Action

MAX MANUAL	2065	+45/-30	65	-105/+385	+90/-70	+55/-55	65	315	840
AUTOBRAKE MAX	2100	+45/-25	65	-105/+390	+80/-65	+55/-60	75	310	825
AUTOBRAKE 3	2455	+50/-30	75	-120/+430	+65/-60	+70/-70	90	160	565

Poor Reported Braking Action

MAX MANUAL	2605	+65/-45	90	-155/+585	+190/-130	+70/-75	75	655	2095
AUTOBRAKE MAX	2615	+65/-45	90	-155/+590	+190/-130	+70/-75	80	655	2095
AUTOBRAKE 3	2755	+65/-45	95	-160/+600	+175/-125	+75/-80	90	555	2000

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

STABILIZER - Flaps 20

VREF30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRKING CONFIGURATION	200000 KG LDG WT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1030	+30/-5	25	-40/+135	+15/-10	+25/-25	35	25	60
AUTOBRAKE MAX	1430	+25/-5	35	-60/+195	0/0	+35/-35	70	0	0
AUTOBRAKE 2	2360	+55/-35	75	-115/+390	+40/-50	+65/-65	90	100	100

Good Reported Braking Action

MAX MANUAL	1435	+30/-15	40	-65/+230	+35/-30	+35/-35	50	105	255
AUTOBRAKE MAX	1535	+30/-10	40	-70/+240	+30/-20	+40/-40	70	110	260
AUTOBRAKE 2	2360	+55/-35	75	-115/+390	+40/-50	+65/-65	90	100	100

Medium Reported Braking Action

MAX MANUAL	1925	+45/-25	60	-105/+375	+85/-65	+50/-50	65	285	770
AUTOBRAKE MAX	1945	+45/-25	60	-105/+375	+80/-60	+50/-55	75	280	755
AUTOBRAKE 3	2250	+45/-25	65	-115/+410	+55/-45	+65/-65	95	135	535

Poor Reported Braking Action

MAX MANUAL	2440	+60/-40	85	-150/+575	+185/-125	+65/-70	75	615	1965
AUTOBRAKE MAX	2450	+65/-40	85	-150/+575	+185/-125	+65/-70	75	615	1970
AUTOBRAKE 3	2555	+60/-35	85	-155/+585	+165/-110	+70/-75	95	540	1905

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		CLIMB LIMIT WEIGHT (1000 KG)			
		AIRPORT PRESSURE ALTITUDE (FT)			
°C	°F	0	1000	2000	3000
54	130	199			
50	122	214	205	196	
45	113	229	220	212	202
40	104	245	235	226	216
35	95	258	252	242	230
30	86	263	260	255	243
25	77	263	261	258	255
20	68	264	261	258	255
15	59	264	261	259	256
10 & BELOW	50 & BELOW	264	262	259	256

Based on engine bleed for 2 packs on and engine anti-ice on or off and wing anti-ice off.
With packs off, increase allowable weight by 2100 kg.
With engine and wing anti-ice on, decrease allowable weight by 900 kg.
Decrease allowable weight by 18000 kg for ice accumulation when operating in icing conditions during any part of the flight with forecast landing temperatures below 10°C.

ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Reference Brake Energy (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)																							
		80				100				120				140				160				180			
WEIGHT (1000 KG)	OAT (°C)	PRESSURE ALTITUDE (1000 FT)																							
		0	2	4	0	2	4	0	2	4	0	2	4	0	2	4	0	2	4	0	2	4			
300	0	18.3	19.2	20.2	27.3	28.8	30.5	37.8	40.0	42.4	49.5	52.5	55.8	62.2	66.0	70.2	75.2	79.8	84.8						
	10	18.8	19.7	20.7	28.2	29.7	31.4	39.0	41.3	43.8	51.1	54.2	57.6	64.2	68.2	72.4	77.5	82.3	87.4						
	15	19.2	20.1	21.1	28.7	30.3	32.0	39.7	42.1	44.6	52.0	55.2	58.6	65.3	69.4	73.7	78.8	83.7	88.8						
	20	19.5	20.4	21.5	29.2	30.8	32.5	40.4	42.8	45.3	52.9	56.1	59.6	66.4	70.5	74.9	80.1	85.0	90.2						
	30	19.9	20.9	22.0	29.9	31.6	33.3	41.5	43.9	46.6	54.4	57.7	61.3	68.3	72.5	77.0	82.3	87.3	92.6						
280	0	17.3	18.2	19.1	25.8	27.2	28.8	35.7	37.7	40.0	46.7	49.5	52.5	58.6	62.2	66.1	70.9	75.3	80.0						
	10	17.8	18.7	19.6	26.6	28.1	29.6	36.8	38.9	41.2	48.2	51.1	54.2	60.5	64.2	68.2	73.2	77.7	82.5						
	15	18.1	19.0	20.0	27.1	28.6	30.2	37.5	39.6	42.0	49.1	52.0	55.2	61.6	65.3	69.4	74.4	79.0	83.9						
	20	18.4	19.3	20.3	27.6	29.1	30.7	38.1	40.3	42.7	49.9	52.9	56.1	62.6	66.4	70.6	75.6	80.3	85.2						
	30	18.9	19.8	20.8	28.3	29.8	31.5	39.1	41.4	43.9	51.3	54.4	57.7	64.4	68.3	72.6	77.8	82.5	87.6						
260	0	16.4	17.2	18.0	24.4	25.7	27.1	33.5	35.5	37.5	43.8	46.4	49.3	54.9	58.3	62.0	66.5	70.7	75.1						
	10	16.8	17.6	18.5	25.1	26.4	27.9	34.6	36.6	38.7	45.2	47.9	50.8	56.7	60.2	63.9	68.7	72.9	77.5						
	15	17.1	18.0	18.9	25.6	26.9	28.4	35.2	37.3	39.4	46.0	48.8	51.7	57.7	61.3	65.1	69.9	74.2	78.8						
	20	17.4	18.3	19.2	26.0	27.4	28.9	35.8	37.9	40.1	46.8	49.6	52.6	58.7	62.3	66.2	71.0	75.4	80.1						
	30	17.8	18.7	19.6	26.6	28.0	29.6	36.8	38.9	41.2	48.1	51.0	54.1	60.3	64.0	68.0	73.0	77.5	82.3						
240	0	15.5	16.2	17.0	22.9	24.1	25.4	31.4	33.2	35.1	40.9	43.3	45.9	51.2	54.3	57.7	62.0	65.9	70.0						
	10	15.9	16.6	17.4	23.5	24.8	26.1	32.4	34.2	36.2	42.2	44.7	47.4	52.8	56.1	59.6	64.0	68.0	72.3						
	15	16.2	16.9	17.7	24.0	25.3	26.6	33.0	34.8	36.9	43.0	45.5	48.3	53.8	57.1	60.6	65.1	69.2	73.5						
	20	16.4	17.2	18.0	24.4	25.7	27.0	33.5	35.4	37.5	43.7	46.3	49.1	54.7	58.0	61.6	66.2	70.3	74.7						
	30	16.8	17.6	18.4	25.0	26.3	27.7	34.4	36.3	38.5	44.9	47.5	50.4	56.2	59.7	63.4	68.1	72.3	76.8						
220	0	14.5	15.2	15.9	21.4	22.5	23.7	29.2	30.9	32.6	37.9	40.2	42.6	47.4	50.3	53.4	57.4	60.9	64.8						
	10	14.9	15.6	16.4	22.0	23.2	24.4	30.1	31.8	33.6	39.1	41.4	43.9	48.9	51.9	55.1	59.2	62.9	66.8						
	15	15.2	15.9	16.7	22.4	23.6	24.8	30.7	32.4	34.2	39.8	42.2	44.7	49.8	52.8	56.1	60.3	64.0	68.0						
	20	15.5	16.2	16.9	22.8	24.0	25.2	31.2	32.9	34.8	40.5	42.9	45.5	50.6	53.7	57.0	61.3	65.1	69.1						
	30	15.8	16.5	17.3	23.3	24.6	25.9	32.0	33.8	35.7	41.6	44.1	46.7	52.1	55.2	58.6	63.0	66.9	71.1						
200	0	13.6	14.3	14.9	19.9	20.9	22.0	27.1	28.5	30.1	35.0	37.0	39.2	43.5	46.1	48.9	52.6	55.8	59.3						
	10	14.0	14.6	15.3	20.5	21.5	22.6	27.9	29.4	31.1	36.0	38.1	40.4	44.9	47.6	50.5	54.3	57.6	61.2						
	15	14.3	14.9	15.6	20.9	21.9	23.0	28.4	29.9	31.7	36.7	38.8	41.1	45.7	48.5	51.4	55.3	58.7	62.3						
	20	14.5	15.1	15.8	21.2	22.3	23.4	28.9	30.4	32.2	37.3	39.5	41.8	46.5	49.3	52.3	56.2	59.7	63.4						
	30	14.8	15.5	16.2	21.7	22.8	24.0	29.6	31.2	33.0	38.3	40.6	43.0	47.8	50.7	53.8	57.8	61.3	65.2						
180	0	12.8	13.3	13.9	18.4	19.4	20.3	24.9	26.2	27.6	31.9	33.8	35.7	39.6	41.9	44.4	47.7	50.6	53.7						
	10	13.1	13.7	14.3	19.0	19.9	20.9	25.6	27.0	28.5	32.9	34.8	36.8	40.8	43.2	45.9	49.2	52.2	55.4						
	15	13.3	13.9	14.6	19.3	20.3	21.3	26.1	27.5	29.0	33.5	35.4	37.5	41.6	44.0	46.7	50.1	53.2	56.4						
	20	13.5	14.1	14.8	19.6	20.6	21.7	26.5	27.9	29.5	34.1	36.0	38.1	42.3	44.8	47.5	51.0	54.1	57.4						
	30	13.8	14.4	15.1	20.1	21.1	22.2	27.2	28.6	30.2	35.0	37.0	39.2	43.4	46.0	48.8	52.4	55.6	59.0						

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.
If ground speed is used for brakes on speed, ignore wind and enter table with sea level, 15°C.

ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Event Adjusted Brake Energy (Millions of Foot Pounds)

No Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)									
EVENT		10	20	30	40	50	60	70	80	90	100
LANDING	RTO MAX MAN	10	20	30	40	50	60	70	80	90	100
	MAX MAN	5.5	14.9	24.1	33.2	42.3	51.4	60.6	69.9	79.3	88.9
	MAX AUTO	5.5	14.0	22.4	31.0	39.6	48.5	57.6	67.0	76.7	86.9
	AUTOBRAKE 4	5.5	13.5	21.4	29.3	37.3	45.5	54.1	63.1	72.6	82.8
	AUTOBRAKE 3	5.5	12.9	20.3	27.6	35.0	42.5	50.5	58.8	67.8	77.4
	AUTOBRAKE 2	5.4	12.4	19.2	25.9	32.7	39.7	46.9	54.6	62.8	71.7
	AUTOBRAKE 1	5.4	11.9	18.2	24.4	30.6	37.0	43.7	50.8	58.5	66.8

2 Engine Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)									
EVENT		10	20	30	40	50	60	70	80	90	100
LANDING	RTO MAX MAN	10	20	30	40	50	60	70	80	90	100
	MAX MAN	4.8	13.6	22.1	30.5	38.8	47.0	55.2	63.4	71.7	80.0
	MAX AUTO	3.0	10.1	17.3	24.5	31.9	39.6	47.5	55.9	64.7	74.0
	AUTOBRAKE 4	2.5	7.9	13.5	19.4	25.6	32.1	39.1	46.6	54.7	63.4
	AUTOBRAKE 3	1.6	5.5	9.7	14.2	19.1	24.5	30.3	36.6	43.4	50.7
	AUTOBRAKE 2	0.9	3.6	6.6	10.0	13.7	17.8	22.4	27.4	32.8	38.7
	AUTOBRAKE 1	0.6	2.7	5.0	7.5	10.3	13.4	16.8	20.7	25.1	30.1

Cooling Time (Minutes)

		EVENT ADJUSTED BRAKE ENERGY (MILLIONS OF FOOT POUNDS)									
		16 & BELOW	17	18	20	24	28	32	35	36 TO 44	45 & ABOVE
INFLIGHT	NO SPECIAL	PROCEDURE REQUIRED	1	1	2	4	5	6	7	CAUTION	FUSE PLUG MELT ZONE
GEAR DOWN			10	13	23	40	53	66	73		
GROUND			10	13	23	40	53	66	73		
BTMS	UP TO 2.4		2.4	2.5	2.9	3.4	4.0	4.4	4.9	5.0 TO 6.3	6.3 & ABOVE

Observe maximum quick turnaround limit.

Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.

Add 1.0 million foot pounds for each taxi mile.

For one brake deactivated, increase brake energy by 10 percent.

For two brakes deactivated, increase brake energy by 20 percent.

When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after one hour. If overheat occurs after takeoff, extend gear soon for at least 8 minutes.

When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not approach gear or attempt to taxi for one hour. Tire, wheel and brake replacement may be required. If overheat occurs after takeoff, extend gear soon for at least 12 minutes.

Brake temperature monitor system (BTMS) indication on EICAS may be used 12 to 15 minutes after airplane has come to a complete stop, or inflight with gear retracted, to determine recommended cooling schedule.

(Inflight gear extended, the BTMS indications may vary between individual brakes, due to airstream effects, gear tilt, and position of the gear temperature probes.)

Intentionally
Blank

Performance Inflight

Engine Inoperative

Chapter PI

Section 13

ENGINE INOP

Initial Max Continuous %N1

Based on .84M, engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	98.7	98.2	97.7	97.3	97.2	96.8	96.9	96.5	96.1
15	99.3	98.8	98.3	97.8	97.8	97.1	97.2	96.8	96.4
10	99.9	99.4	98.9	98.4	98.4	97.7	97.8	97.4	97.1
5	100.3	100.1	99.5	99.1	99.0	98.3	98.4	98.1	97.7
0	99.4	100.3	100.2	99.7	99.6	99.0	99.1	98.7	98.4
-5	98.5	99.4	100.4	100.6	100.4	99.6	99.8	99.4	99.0
-10	97.6	98.5	99.5	100.7	101.6	100.6	100.7	100.3	99.9
-15	96.6	97.6	98.5	99.7	101.5	101.5	101.6	101.2	100.8
-20	95.7	96.6	97.6	98.7	100.5	100.6	100.6	100.2	99.9
-25	94.8	95.6	96.6	97.7	99.5	99.6	99.6	99.3	98.9
-30	93.8	94.7	95.6	96.8	98.5	98.6	98.6	98.2	97.9
-35	92.8	93.7	94.6	95.8	97.5	97.5	97.6	97.2	96.9
-40	91.8	92.7	93.6	94.7	96.5	96.5	96.5	96.2	95.8

ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
37000 FT to 27000 FT Pressure Altitudes

37000 FT PRESS ALT													TAT (°C)	
CIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	
200	0.63	95.1	96.1	97.2	98.2	99.2	100.2	100.8	100.4	99.6	98.9	98.2	98.0	
240	0.74	95.1	96.1	97.2	98.2	99.3	100.3	101.0	100.9	100.2	99.3	98.6	98.0	
280	0.86	94.0	95.1	96.1	97.1	98.2	99.2	100.2	101.1	100.7	99.7	99.0	98.4	
35000 FT PRESS ALT													TAT (°C)	
CIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	
200	0.60	94.8	95.9	96.9	98.0	99.0	100.0	101.0	101.2	100.4	99.6	98.8	98.5	
240	0.71	94.9	95.9	97.0	98.0	99.0	100.0	101.0	101.6	100.9	99.9	99.2	98.7	
280	0.82	94.7	95.8	96.8	97.9	98.9	99.9	100.9	101.9	101.3	100.3	99.6	98.9	
33000 FT PRESS ALT													TAT (°C)	
CIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	
200	0.58	94.8	95.8	96.9	97.9	98.9	99.9	100.9	101.3	100.6	99.7	98.9	98.1	
240	0.68	94.7	95.7	96.8	97.8	98.8	99.8	100.8	101.2	100.8	100.0	99.3	98.6	
280	0.79	93.8	94.8	95.8	96.9	97.9	98.9	99.9	100.9	101.3	100.4	99.6	98.9	
320	0.89	91.4	92.5	93.5	94.5	95.5	96.4	97.4	98.4	99.3	100.2	99.9	99.2	
31000 FT PRESS ALT													TAT (°C)	
CIAS	M	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	
200	0.55	95.8	96.8	97.8	98.9	99.9	100.8	101.4	101.1	100.2	99.3	98.5	97.8	
240	0.66	95.5	96.5	97.6	98.6	99.6	100.6	101.4	101.2	100.4	99.6	99.0	98.3	
280	0.76	94.4	95.4	96.4	97.4	98.4	99.4	100.4	101.3	100.8	99.9	99.3	98.6	
320	0.85	92.3	93.3	94.3	95.2	96.2	97.2	98.1	99.1	100.0	100.3	99.5	98.9	
29000 FT PRESS ALT													TAT (°C)	
CIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	
200	0.53	96.7	97.7	98.7	99.7	100.7	101.5	101.6	100.8	99.8	98.9	98.0	98.1	
240	0.63	96.2	97.2	98.2	99.2	100.2	101.2	101.5	101.0	100.1	99.4	98.7	98.0	
280	0.73	95.1	96.2	97.2	98.2	99.1	100.1	101.1	101.3	100.4	99.7	99.1	98.5	
320	0.82	93.1	94.1	95.1	96.1	97.0	98.0	98.9	99.9	100.8	100.0	99.4	98.7	
360	0.91	91.0	92.0	93.0	93.9	94.9	95.8	96.7	97.6	98.5	99.4	99.7	99.1	
27000 FT PRESS ALT													TAT (°C)	
CIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	
200	0.51	96.5	97.5	98.6	99.6	100.6	101.5	101.9	101.4	100.4	99.4	98.5	97.5	
240	0.60	95.9	96.9	97.9	98.9	99.9	100.9	101.7	101.5	100.7	99.9	99.2	98.4	
280	0.70	94.8	95.8	96.8	97.8	98.7	99.7	100.7	101.6	101.0	100.2	99.5	98.9	
320	0.79	92.9	93.9	94.9	95.9	96.8	97.8	98.7	99.7	100.6	100.5	99.8	99.2	
360	0.88	90.9	91.9	92.9	93.8	94.8	95.7	96.6	97.5	98.4	99.3	100.0	99.4	

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESS ALT (1000 FT)					
	37	35	33	31	29	27
ENGINE ANTI-ICE ON	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
ENGINE & WING ANTI-ICE ON (packs on)	-1.0	-1.0	-0.9	-0.9	-0.8	-0.8
ENGINE & WING ANTI-ICE ON (packs off)	-1.7	-1.6	-1.5	-1.4	-1.3	-1.2

ENGINE INOP**Max Continuous %N1****Based on engine bleed for packs on or off and anti-ice off****25000 FT to 18000 FT Pressure Altitudes**

25000 FT PRESS ALT												TAT (°C)	
CIAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	0.49	97.5	98.5	99.5	100.5	101.5	102.2	101.9	100.9	99.9	98.9	97.9	97.7
240	0.58	96.7	97.7	98.7	99.7	100.6	101.6	101.8	101.1	100.3	99.6	98.8	98.0
280	0.67	95.3	96.3	97.2	98.2	99.2	100.1	101.1	101.3	100.6	100.0	99.3	98.7
320	0.76	93.6	94.6	95.5	96.5	97.4	98.4	99.3	100.2	100.9	100.2	99.6	99.0
360	0.85	91.8	92.7	93.7	94.6	95.5	96.5	97.4	98.3	99.2	100.1	99.8	99.2
24000 FT PRESS ALT												TAT (°C)	
CIAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	0.48	97.4	98.4	99.4	100.4	101.4	102.2	102.2	101.2	100.2	99.2	98.2	97.4
240	0.57	96.4	97.4	98.4	99.4	100.4	101.4	102.0	101.5	100.6	99.9	99.1	98.2
280	0.66	95.1	96.1	97.1	98.0	99.0	100.0	100.9	101.6	100.9	100.2	99.6	98.9
320	0.75	93.5	94.4	95.4	96.4	97.3	98.3	99.2	100.1	101.0	100.5	99.8	99.3
360	0.83	91.7	92.7	93.6	94.6	95.5	96.4	97.3	98.2	99.1	100.0	100.1	99.4
22000 FT PRESS ALT												TAT (°C)	
CIAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
200	0.46	98.1	99.1	100.1	101.0	102.0	102.4	101.7	100.7	99.7	98.7	97.8	97.7
240	0.55	97.0	98.0	99.0	100.0	101.0	101.9	101.9	101.2	100.4	99.6	98.8	98.0
280	0.63	95.8	96.8	97.7	98.7	99.6	100.6	101.5	101.4	100.7	100.1	99.4	98.7
320	0.72	94.2	95.1	96.1	97.0	98.0	98.9	99.8	100.7	100.9	100.3	99.7	99.1
360	0.80	92.5	93.5	94.4	95.3	96.3	97.2	98.1	99.0	99.9	100.5	99.9	99.3
20000 FT PRESS ALT												TAT (°C)	
CIAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
200	0.44	97.7	98.7	99.7	100.7	101.7	102.6	102.3	101.3	100.3	99.3	98.4	97.7
240	0.53	96.7	97.7	98.7	99.7	100.6	101.6	102.4	101.8	101.0	100.2	99.3	98.6
280	0.61	95.5	96.5	97.5	98.4	99.4	100.3	101.3	102.0	101.3	100.6	99.9	99.2
320	0.69	93.9	94.8	95.8	96.7	97.7	98.6	99.5	100.4	101.3	100.8	100.0	99.2
360	0.77	92.4	93.4	94.3	95.2	96.1	97.0	98.0	98.8	99.7	100.6	100.3	99.6
18000 FT PRESS ALT												TAT (°C)	
CIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	0.42	98.3	99.2	100.2	101.2	102.1	102.6	101.6	100.5	99.5	98.6	97.8	97.4
240	0.51	97.2	98.1	99.1	100.0	101.0	101.9	102.0	101.1	100.2	99.4	98.7	98.0
280	0.59	95.6	96.5	97.5	98.4	99.3	100.3	101.2	101.2	100.4	99.8	99.2	98.6
320	0.67	94.1	95.0	95.9	96.9	97.8	98.7	99.6	100.5	100.7	100.1	99.5	98.9
360	0.75	92.7	93.6	94.5	95.4	96.3	97.2	98.1	99.0	99.9	100.3	99.8	99.2

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESS ALT (1000 FT)				
	25	24	22	20	18
ENGINE ANTI-ICE ON	-0.4	-0.4	-0.4	-0.4	-0.4
ENGINE & WING ANTI-ICE ON (packs on)	-0.8	-0.7	-0.7	-0.5	-0.5
ENGINE & WING ANTI-ICE ON (packs off)	-1.1	-1.1	-1.0	-0.7	-0.7

ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
16000 FT to 5000 FT Pressure Altitudes

16000 FT PRESS ALT			TAT (°C)										
CIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	0.41	97.1	98.1	99.0	100.0	100.9	101.9	101.7	100.6	99.6	98.7	97.9	97.1
240	0.49	96.2	97.1	98.1	99.0	100.0	100.9	101.8	101.2	100.2	99.4	98.6	97.9
280	0.57	94.7	95.7	96.6	97.6	98.5	99.4	100.3	101.2	100.5	99.8	99.1	98.3
320	0.64	93.4	94.3	95.2	96.1	97.0	97.9	98.8	99.7	100.6	100.0	99.5	98.8
360	0.72	92.1	93.0	93.9	94.8	95.7	96.6	97.5	98.3	99.2	100.1	99.8	99.2
14000 FT PRESS ALT			TAT (°C)										
CIAS	M	-20	-15	-10	-5	0	5	10	15	20	25	30	35
200	0.39	96.7	97.7	98.6	99.6	100.5	101.4	100.5	99.5	98.6	97.8	97.1	96.3
240	0.47	95.9	96.8	97.8	98.7	99.6	100.5	101.1	100.2	99.4	98.5	97.8	97.0
280	0.54	94.9	95.8	96.7	97.6	98.5	99.4	100.3	100.7	100.0	99.2	98.3	97.5
320	0.62	93.8	94.7	95.6	96.5	97.4	98.3	99.2	100.1	100.4	99.7	99.0	98.1
360	0.69	92.5	93.4	94.3	95.2	96.1	96.9	97.8	98.7	99.5	99.9	99.3	98.6
12000 FT PRESS ALT			TAT (°C)										
CIAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40
200	0.38	96.4	97.4	98.3	99.2	100.1	100.6	99.7	98.7	97.9	97.1	96.3	95.5
240	0.45	95.8	96.7	97.7	98.6	99.5	100.4	100.3	99.4	98.6	97.7	96.8	96.0
280	0.52	95.0	96.0	96.9	97.8	98.7	99.5	100.4	100.0	99.2	98.5	97.5	96.7
320	0.60	93.9	94.8	95.7	96.6	97.5	98.4	99.2	100.1	99.7	99.0	98.2	97.3
360	0.67	92.7	93.6	94.5	95.4	96.3	97.1	98.0	98.8	99.7	99.3	98.6	97.8
10000 FT PRESS ALT			TAT (°C)										
CIAS	M	-15	10	-5	0	5	10	15	20	25	30	35	40
200	0.36	95.4	96.3	97.2	98.1	99.0	99.9	99.8	98.9	98.1	97.3	96.5	95.7
240	0.43	94.8	95.7	96.6	97.5	98.4	99.3	100.1	99.5	98.7	97.9	96.9	96.1
280	0.51	94.1	95.0	95.9	96.8	97.7	98.6	99.4	100.1	99.3	98.5	97.7	96.8
320	0.58	93.1	94.0	94.9	95.8	96.7	97.5	98.4	99.3	99.7	99.0	98.2	97.4
360	0.65	92.0	92.9	93.8	94.6	95.5	96.3	97.2	98.0	98.9	99.2	98.6	97.8
5000 FT PRESS ALT			TAT (°C)										
CIAS	M	-10	-5	0	5	10	15	20	25	30	35	40	45
200	0.33	92.4	93.3	94.1	95.0	95.8	96.7	97.5	97.3	96.6	95.8	94.9	94.1
240	0.40	92.0	92.9	93.7	94.6	95.4	96.3	97.1	97.7	97.0	96.2	95.3	94.5
280	0.46	91.6	92.4	93.3	94.2	95.0	95.8	96.7	97.5	97.5	96.7	95.9	95.0
320	0.53	91.0	91.8	92.7	93.5	94.4	95.2	96.0	96.8	97.6	97.2	96.4	95.6
360	0.59	90.2	91.0	91.9	92.7	93.5	94.4	95.2	96.0	96.8	97.6	96.9	96.1

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESS ALT (1000 FT)				
	16	14	12	10	5
ENGINE ANTI-ICE ON	-0.4	-0.4	-0.4	-0.4	-0.3
ENGINE & WING ANTI-ICE ON (packs on)	-0.5	-0.5	-0.5	-0.5	-0.5
ENGINE & WING ANTI-ICE ON (packs off)	-0.7	-0.7	-0.7	-0.7	-0.7

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

Includes APU fuel burn

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
260	252	263	19700	18400	16600
240	232	253	22000	21000	19700
220	213	243	24200	23500	22300
200	194	232	26600	26000	25000
180	174	220	29000	28700	27900
160	155	208	31600	31500	31000

ENGINE INOP

MAX CONTINUOUS THRUST

**Driftdown/LRC Cruise Range Capability
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
134	125	118	111	105	100	95	91	87	83	80
273	255	238	224	211	200	190	181	172	165	158
412	383	358	337	317	300	285	271	258	246	236
550	511	478	449	423	400	379	361	344	329	314
686	639	597	561	529	500	474	451	430	411	393
822	765	716	673	634	600	569	541	516	493	472
958	892	835	784	740	700	664	632	603	576	552
1093	1018	953	896	845	800	759	723	689	659	631
1227	1144	1071	1007	951	900	854	813	776	742	711
1362	1270	1190	1119	1056	1000	950	904	863	825	790
1496	1395	1308	1230	1161	1100	1045	995	949	908	870
1630	1521	1426	1342	1267	1200	1140	1085	1036	991	949
1765	1647	1544	1453	1372	1300	1235	1176	1123	1074	1029
1900	1773	1662	1565	1478	1400	1330	1267	1209	1157	1108
2035	1900	1781	1676	1583	1500	1425	1357	1296	1239	1188
2171	2027	1900	1788	1689	1600	1520	1448	1382	1322	1267
2308	2154	2019	1900	1795	1700	1615	1538	1468	1404	1346
2445	2282	2139	2012	1900	1800	1710	1628	1554	1486	1424

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG)						TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 KG)						
	160	180	200	220	240	260	
100	0.9	1.0	1.0	1.1	1.2	1.3	0:15
200	2.1	2.3	2.5	2.7	2.9	3.1	0:32
300	3.4	3.7	4.1	4.4	4.8	5.2	0:49
400	4.7	5.2	5.7	6.2	6.7	7.2	1:05
500	6.0	6.6	7.3	8.0	8.6	9.3	1:21
600	7.2	8.0	8.8	9.6	10.4	11.2	1:37
700	8.4	9.3	10.3	11.3	12.2	13.1	1:53
800	9.6	10.7	11.8	12.9	13.9	15.0	2:09
900	10.8	12.0	13.3	14.5	15.7	16.9	2:24
1000	12.0	13.3	14.7	16.1	17.5	18.8	2:39
1100	13.2	14.7	16.2	17.7	19.2	20.7	2:55
1200	14.4	16.0	17.6	19.3	20.9	22.5	3:10
1300	15.5	17.3	19.1	20.9	22.6	24.4	3:25
1400	16.7	18.6	20.5	22.4	24.3	26.2	3:41
1500	17.8	19.8	21.9	24.0	26.0	28.0	3:57
1600	18.9	21.1	23.3	25.5	27.6	29.8	4:13
1700	20.0	22.3	24.7	27.0	29.3	31.6	4:29
1800	21.1	23.6	26.1	28.5	30.9	33.4	4:45

APU fuel included.

Driftdown at optimum speed and cruise at LRC speed.

ENGINE INOP**MAX CONTINUOUS THRUST****Long Range Cruise Altitude Capability****100 ft/min residual rate of climb**

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
260	15400	13400	10700
240	18500	16300	14400
220	21300	20100	18000
200	23900	22900	21500
180	26600	25800	24600
160	29500	28900	27900
140	32400	32200	31400

With engine anti-ice on, decrease altitude capability by 700 ft.

With engine and wing anti-ice on, decrease altitude capability by 1100 ft.

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)							
		10	15	17	19	21	23	25	27
260	%N1	91.5	95.9	97.6					
	MACH	.557	.602	.624					
	KIAS	309	305	304					
	FF/ENG	7544	7611	7718					
240	%N1	89.2	93.5	95.2	97.1				
	MACH	.541	.582	.602	.625				
	KIAS	300	294	293	293				
	FF/ENG	6945	6927	6973	7082				
220	%N1	86.6	90.9	92.6	94.4	96.3			
	MACH	.523	.563	.581	.601	.624			
	KIAS	290	285	283	281	281			
	FF/ENG	6360	6291	6302	6339	6448			
200	%N1	83.9	88.3	89.9	91.7	93.5	95.3	98.2	
	MACH	.504	.544	.561	.578	.598	.621	.653	
	KIAS	279	275	272	270	269	268	272	
	FF/ENG	5797	5700	5677	5683	5711	5811	6096	
180	%N1	81.3	85.3	87.0	88.7	90.4	92.2	94.0	96.6
	MACH	.486	.523	.539	.556	.574	.593	.615	.646
	KIAS	269	263	262	259	257	256	255	257
	FF/ENG	5264	5145	5101	5071	5067	5086	5163	5384
160	%N1	78.6	82.1	83.8	85.5	87.2	88.9	90.6	92.4
	MACH	.468	.499	.515	.532	.549	.566	.585	.607
	KIAS	259	251	250	248	246	244	242	241
	FF/ENG	4777	4580	4553	4511	4470	4457	4468	4522
140	%N1	75.8	79.0	80.4	81.9	83.6	85.4	87.0	88.7
	MACH	.449	.477	.490	.505	.522	.539	.557	.575
	KIAS	248	240	237	235	233	232	230	228
	FF/ENG	4333	4071	4015	3973	3925	3879	3863	3881

ENGINE INOP

MAX CONTINUOUS THRUST

**Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
289	266	245	228	213	200	191	182	174	167	160
581	534	492	457	427	400	381	364	348	333	320
873	802	739	686	641	600	572	545	521	500	480
1166	1071	987	916	855	800	762	726	694	665	639
1460	1340	1235	1145	1069	1000	952	908	867	831	798
1755	1611	1483	1375	1283	1200	1142	1089	1040	996	956
2051	1881	1732	1605	1497	1400	1333	1270	1213	1161	1114
2348	2153	1980	1836	1711	1600	1523	1451	1386	1326	1272
2645	2424	2230	2066	1925	1800	1713	1632	1558	1491	1430
2943	2697	2479	2297	2140	2000	1902	1812	1730	1655	1588

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	3.3	0:40	2.9	0:39	2.6	0:38	2.4	0:36	2.2	0:34
400	7.0	1:18	6.4	1:15	5.9	1:12	5.5	1:09	5.3	1:05
600	10.6	1:56	9.8	1:51	9.1	1:46	8.6	1:42	8.4	1:35
800	14.1	2:34	13.1	2:27	12.3	2:21	11.6	2:15	11.4	2:06
1000	17.7	3:12	16.5	3:04	15.4	2:56	14.7	2:48	14.4	2:37
1200	21.2	3:51	19.8	3:41	18.5	3:31	17.6	3:21	17.3	3:08
1400	24.7	4:30	23.0	4:18	21.6	4:06	20.6	3:55	20.2	3:40
1600	28.1	5:09	26.3	4:56	24.7	4:42	23.5	4:29	23.0	4:12

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)						
	140	160	180	200	220	240	260
5	-0.7	-0.5	-0.2	0.0	0.5	1.0	1.5
10	-1.4	-1.0	-0.5	0.0	1.1	2.2	3.4
15	-2.2	-1.5	-0.8	0.0	1.7	3.4	5.2
20	-2.9	-2.0	-1.0	0.0	2.2	4.5	7.0
25	-3.6	-2.5	-1.3	0.0	2.7	5.6	8.8
30	-4.3	-3.0	-1.6	0.0	3.2	6.7	10.5

ENGINE INOP
MAX CONTINUOUS THRUST

**Holding
Flaps Up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
260	%N1	79.8	82.7	87.5	92.4		
	KIAS	236	237	238	240		
	FF/ENG	6860	6650	6630	6770		
240	%N1	77.5	80.3	84.8	89.8	94.9	
	KIAS	229	229	229	229	242	
	FF/ENG	6320	6110	6090	6160	6380	
220	%N1	75.0	77.8	82.0	87.0	92.0	
	KIAS	223	223	223	223	224	
	FF/ENG	5800	5600	5560	5570	5660	
200	%N1	72.4	75.1	79.2	84.0	88.9	94.3
	KIAS	216	216	216	216	216	225
	FF/ENG	5260	5120	5060	5040	5050	5310
180	%N1	69.5	72.2	76.2	80.9	85.7	90.7
	KIAS	209	209	209	209	209	209
	FF/ENG	4730	4670	4580	4520	4480	4570

This table includes 5% additional fuel for holding in a racetrack pattern.

ENGINE INOP

ADVISORY INFORMATION

**Gear Down Landing Rate of Climb Available
Flaps 20**

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	240	140				
50	280	200	60			
48	320	240	110			
46	360	290	170			
44	400	330	210	50		
42	440	380	260	100	-60	
40	470	430	300	150	-10	
38	510	470	350	190	40	-130
36	530	510	400	230	80	-80
34	530	540	450	280	120	-30
32	530	560	480	320	160	0
30	540	560	520	370	200	40
20	550	580	560	520	400	240
10	570	600	570	530	450	340
0	590	610	590	550	460	350
-20	610	640	610	570	480	370
-40	640	670	640	590	500	380

Rate of climb capability shown is valid for 180000 kg, gear down at VREF20 + 5.

Decrease rate of climb 45 ft/min per 5000 kg greater than 180000 kg.

Increase rate of climb 55 ft/min per 5000 kg less than 180000 kg.

Flaps 30

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	-210	-320				
50	-180	-270	-400			
48	-150	-230	-360			
46	-110	-190	-310	-470		
44	-70	-150	-270	-430		
42	-40	-110	-230	-380	-540	
40	-10	-60	-180	-340	-500	
38	20	-20	-140	-300	-450	-620
36	40	10	-100	-260	-420	-570
34	40	40	-60	-220	-380	-530
32	40	50	-30	-180	-340	-500
30	40	60	10	-140	-310	-460
20	50	60	30	-10	-130	-290
10	60	70	40	-10	-100	-210
0	70	80	40	0	-100	-210
-20	70	80	50	0	-100	-210
-40	70	90	50	0	-100	-220

Rate of climb capability shown is valid for 180000 kg, gear down at VREF30 + 5.

Decrease rate of climb 50 ft/min per 5000 kg greater than 180000 kg.

Increase rate of climb 60 ft/min per 5000 kg less than 180000 kg.

Performance Inflight
Chapter PI
Gear Down
Section 14

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
260	17400	15300	12200
240	20900	18400	15600
220	24500	22000	19600
200	27800	26400	23800
180	30900	30500	28900
160	33400	33300	32900
140	36100	36100	36100

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
260	%N1	84.5	89.2	90.9							
	MACH	.453	.492	.508							
	KIAS	251	248	246							
	FF/ENG	5792	5756	5759							
240	%N1	82.1	86.8	88.6	90.4	92.1					
	MACH	.438	.476	.492	.508	.525					
	KIAS	242	240	238	237	235					
	FF/ENG	5337	5288	5273	5275	5290					
220	%N1	79.5	84.1	86.0	87.8	89.6	91.4	93.3			
	MACH	.421	.459	.475	.491	.508	.525	.543			
	KIAS	232	231	230	228	227	225	224			
	FF/ENG	4886	4841	4810	4793	4791	4806	4864			
200	%N1	76.8	81.4	83.1	85.0	86.8	88.6	90.5	92.7		
	MACH	.403	.441	.456	.473	.489	.506	.526	.548		
	KIAS	223	221	220	219	218	217	216	216		
	FF/ENG	4448	4391	4371	4333	4309	4314	4361	4463		
180	%N1	73.8	78.4	80.0	81.8	83.9	85.9	87.9	89.9	92.1	
	MACH	.384	.420	.436	.452	.470	.489	.509	.531	.554	
	KIAS	212	211	210	210	209	209	209	209	209	
	FF/ENG	4011	3934	3926	3975	3941	3878	3931	3984	4071	
160	%N1	70.7	75.6	77.2	79.0	81.1	83.2	85.1	87.1	89.2	91.3
	MACH	.366	.403	.419	.436	.454	.472	.492	.513	.535	.558
	KIAS	202	202	202	202	202	202	202	202	202	202
	FF/ENG	3693	3613	3608	3609	3595	3563	3512	3564	3604	3670
140	%N1	67.8	72.7	74.4	76.1	78.1	80.2	82.2	84.1	86.1	88.2
	MACH	.352	.387	.403	.419	.436	.454	.473	.493	.515	.537
	KIAS	194	194	194	194	194	194	194	194	194	194
	FF/ENG	3358	3267	3255	3251	3245	3228	3206	3208	3194	3226

GEAR DOWN

**Long Range Cruise Enroute Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
322	287	258	235	216	200	189	178	169	160	153
655	584	522	474	434	400	377	357	338	321	306
992	882	788	714	653	600	566	535	507	482	460
1332	1183	1055	954	872	800	755	713	676	642	612
1675	1485	1323	1195	1091	1000	943	891	844	802	765
2021	1790	1592	1436	1310	1200	1131	1069	1012	962	917
2371	2096	1862	1678	1529	1400	1320	1246	1180	1121	1069
2725	2406	2134	1921	1749	1600	1508	1424	1348	1280	1221
3081	2717	2407	2164	1969	1800	1696	1601	1515	1439	1372
3442	3031	2681	2408	2190	2000	1884	1778	1683	1598	1523
3805	3346	2956	2653	2410	2200	2072	1955	1850	1756	1674
4172	3664	3233	2899	2631	2400	2260	2132	2017	1914	1824
4543	3985	3512	3145	2853	2600	2447	2308	2183	2072	1974
4919	4308	3791	3392	3074	2800	2635	2485	2349	2229	2124
5298	4634	4073	3640	3296	3000	2822	2661	2515	2386	2273
5681	4963	4355	3889	3519	3200	3010	2837	2681	2543	2422
6069	5294	4639	4138	3742	3400	3197	3012	2846	2699	2570
6460	5627	4925	4388	3965	3600	3384	3188	3012	2855	2719
6856	5963	5212	4639	4188	3800	3571	3363	3177	3011	2867
7255	6302	5500	4891	4412	4000	3758	3538	3341	3166	3014

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME
	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)
200	6.6	0:46	6.0	0:45	5.2	0:43	4.9	0:42	4.7	0:40
400	13.2	1:36	12.1	1:32	10.7	1:25	10.1	1:22	9.7	1:17
600	19.7	2:25	18.2	2:18	16.3	2:08	15.3	2:01	14.8	1:54
800	26.2	3:15	24.3	3:05	21.9	2:50	20.5	2:41	19.8	2:32
1000	32.7	4:05	30.3	3:51	27.4	3:33	25.7	3:21	24.9	3:09
1200	38.9	4:57	36.1	4:40	32.7	4:17	30.6	4:02	29.5	3:47
1400	45.1	5:49	41.9	5:29	38.0	5:01	35.5	4:43	34.2	4:26
1600	51.3	6:41	47.6	6:18	43.3	5:45	40.4	5:24	38.9	5:04
1800	57.5	7:33	53.4	7:06	48.6	6:29	45.4	6:05	43.6	5:42
2000	63.7	8:26	59.1	7:55	53.9	7:13	50.3	6:46	48.3	6:21
2200	69.3	9:21	64.4	8:47	58.7	7:59	54.8	7:29	52.7	7:01
2400	75.0	10:17	69.7	9:38	63.6	8:46	59.4	8:12	57.0	7:41
2600	80.7	11:12	75.0	10:30	68.4	9:32	64.0	8:55	61.4	8:21
2800	86.3	12:08	80.3	11:22	73.3	10:18	68.6	9:38	65.7	9:01
3000	92.0	13:03	85.6	12:13	78.2	11:05	73.2	10:21	70.1	9:41
3200	97.2	14:03	90.5	13:08	82.7	11:53	77.4	11:07	74.0	10:23
3400	102.3	15:02	95.3	14:03	87.1	12:42	81.7	11:52	78.0	11:05
3600	107.5	16:01	100.2	14:57	91.6	13:31	85.9	12:37	82.0	11:47
3800	112.7	17:00	105.0	15:52	96.1	14:20	90.2	13:22	86.0	12:29
4000	117.8	17:59	109.9	16:47	100.6	15:08	94.4	14:07	90.0	13:10

GEAR DOWN

**Long Range Cruise Enroute Fuel and Time
Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	160	180	200	220	240
10	-0.7	-0.3	0.0	0.9	2.0
20	-1.6	-0.8	0.0	1.7	3.8
30	-2.6	-1.2	0.0	2.5	5.4
40	-3.6	-1.7	0.0	3.2	6.9
50	-4.5	-2.2	0.0	3.9	8.3
60	-5.5	-2.7	0.0	4.5	9.7
70	-6.6	-3.2	0.0	5.1	10.9
80	-7.6	-3.7	0.0	5.7	12.0
90	-8.7	-4.2	0.0	6.2	13.0
100	-9.7	-4.7	0.0	6.7	13.9
110	-10.8	-5.3	0.0	7.1	14.7
120	-11.9	-5.9	0.0	7.5	15.4
130	-13.0	-6.5	0.0	7.9	15.9

Descent at VREF30 + 80

PRESSURE ALTITUDE (1000 FT)	17	19	21	23	25	27	29	31	33	35
DISTANCE (NM)	40	44	48	52	56	60	64	68	72	76
TIME (MINUTES)	11	12	13	13	14	15	16	16	17	18

GEAR DOWN

**Holding
Flaps Up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)							
		1500	5000	10000	15000	20000	25000	30000	35000
260	%N1	75.2	78	82.5	87.6	92.7			
	KIAS	236	236	236	236	236			
	FF/ENG	5840	5660	5660	5700	5850			
240	%N1	73.2	76.1	80.3	85.4	90.5			
	KIAS	229	229	229	229	229			
	FF/ENG	5440	5300	5260	5280	5360			
220	%N1	71.2	73.9	78.1	83	88	93.2		
	KIAS	223	223	223	223	223	223		
	FF/ENG	5060	4950	4880	4880	4900	5090		
200	%N1	69	71.7	75.8	80.6	85.5	90.5		
	KIAS	216	216	216	216	216	216		
	FF/ENG	4680	4610	4510	4480	4470	4580		
180	%N1	66.7	69.3	73.3	78.2	82.8	87.9	93.4	
	KIAS	209	209	209	209	209	209	209	
	FF/ENG	4320	4260	4150	4090	4150	4130	4340	
160	%N1	64.2	66.8	70.7	75.6	79.9	85.1	90.2	
	KIAS	202	202	202	202	202	202	202	
	FF/ENG	4030	3990	3880	3790	3790	3690	3810	
140	%N1	61.5	64.1	67.8	72.7	77	82.2	87.1	92.9
	KIAS	194	194	194	194	194	194	194	194
	FF/ENG	3660	3630	3530	3430	3410	3370	3370	3570

Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
260	%N1	73.8	76.7	81.2	86.4	91.5
	KIAS	216	216	216	216	216
	FF/ENG	5530	5380	5380	5440	5530
240	%N1	71.6	74.5	78.9	84.0	89.1
	KIAS	209	209	209	209	209
	FF/ENG	5130	5020	4980	5020	5060
220	%N1	69.3	72.1	76.5	81.5	86.6
	KIAS	203	203	203	203	203
	FF/ENG	4730	4670	4600	4600	4600
200	%N1	66.8	69.6	73.9	78.9	83.8
	KIAS	196	196	196	196	196
	FF/ENG	4330	4310	4210	4180	4170
180	%N1	64.2	66.9	71.1	76.2	80.8
	KIAS	189	189	189	189	189
	FF/ENG	4030	4010	3910	3860	3870
160	%N1	61.4	64.1	68.1	73.2	77.7
	KIAS	182	182	182	182	182
	FF/ENG	3650	3630	3530	3470	3480
140	%N1	58.4	61.0	64.9	69.9	74.4
	KIAS	174	174	174	174	174
	FF/ENG	3270	3250	3160	3100	3100

These tables include 5% additional fuel for holding in a racetrack pattern.

Performance Inflight
Chapter PI
Gear Down, Engine INOP
Section 15

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		VREF + 80 DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
220	208	221	4700		
200	190	214	9400	6200	3800
180	172	208	13000	11000	8100
160	154	200	16400	14900	12800

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
200	6400	4100	
180	11700	8200	5900
160	15200	13600	11200
140	18700	17700	15800

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)					
		5	7	9	11	13	15
200	%N1	92.5	94.5	96.5			
	MACH	.358	.371	.385			
	KIAS	216	216	216			
	FF/ENG	8649	8653	8728			
180	%N1	89.6	91.6	93.6	95.6	97.9	
	MACH	.346	.359	.373	.387	.402	
	KIAS	209	209	209	209	209	
	FF/ENG	7860	7852	7900	7957	8109	
160	%N1	86.5	88.5	90.5	92.5	94.5	96.7
	MACH	.334	.346	.359	.373	.388	.403
	KIAS	202	202	202	202	202	202
	FF/ENG	7101	7080	7111	7147	7207	7327
140	%N1	83.1	85.1	87.1	89.1	91.1	93.0
	MACH	.321	.333	.345	.359	.373	.387
	KIAS	194	194	194	194	194	194
	FF/ENG	6375	6348	6356	6373	6409	6461

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
349	305	269	241	219	200	186	174	163	154	146
529	462	406	363	329	300	279	261	244	230	218
710	620	544	486	440	400	372	347	325	306	289
891	777	681	608	550	500	465	433	405	381	361
1074	936	819	730	660	600	557	519	486	457	432
1258	1095	957	853	771	700	650	606	567	533	504
1443	1255	1096	976	881	800	743	692	647	608	575
1629	1415	1235	1099	992	900	836	778	727	683	646
1815	1576	1374	1222	1102	1000	928	864	808	759	717
2003	1737	1515	1346	1213	1100	1021	950	888	834	788
2191	1900	1655	1470	1324	1200	1114	1036	968	909	859
2381	2062	1795	1593	1435	1300	1206	1122	1048	984	930
2571	2226	1936	1717	1546	1400	1298	1207	1127	1058	1000
2763	2390	2077	1841	1658	1500	1391	1293	1207	1133	1070
2955	2554	2219	1966	1769	1600	1483	1379	1287	1207	1140

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	6		8		10		12		14	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	6.6	0:54	6.3	0:53	6.1	0:51	5.8	0:51	5.7	0:49
300	10.0	1:21	9.6	1:19	9.3	1:16	9.0	1:15	8.8	1:13
400	13.4	1:47	12.9	1:45	12.6	1:42	12.2	1:39	11.9	1:37
500	16.7	2:15	16.2	2:11	15.7	2:07	15.3	2:04	15.0	2:01
600	20.0	2:42	19.4	2:37	18.9	2:33	18.3	2:29	18.0	2:25
700	23.3	3:09	22.6	3:04	22.0	2:58	21.4	2:54	21.0	2:49
800	26.6	3:36	25.8	3:30	25.1	3:24	24.4	3:19	24.0	3:13
900	29.7	4:04	28.9	3:57	28.1	3:50	27.4	3:44	26.9	3:37
1000	32.9	4:32	32.0	4:24	31.1	4:16	30.3	4:09	29.8	4:02
1100	36.1	5:00	35.0	4:51	34.1	4:43	33.2	4:35	32.6	4:27
1200	39.2	5:28	38.0	5:18	37.1	5:09	36.1	5:00	35.4	4:51
1300	42.2	5:57	41.0	5:46	40.0	5:36	38.9	5:26	38.2	5:16
1400	45.3	6:25	44.0	6:14	42.9	6:02	41.8	5:52	41.0	5:42
1500	48.3	6:54	46.9	6:42	45.7	6:29	44.6	6:18	43.7	6:07
1600	51.3	7:23	49.8	7:09	48.5	6:56	47.3	6:44	46.4	6:32

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time
Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)					
	140	160	180	200	220	240
5	-0.6	-0.3	0.0	0.5	1.1	1.7
10	-1.2	-0.6	0.0	1.0	2.2	3.5
15	-1.8	-0.9	0.0	1.5	3.3	5.2
20	-2.4	-1.2	0.0	1.9	4.3	6.8
25	-2.9	-1.5	0.0	2.3	5.2	8.3
30	-3.5	-1.8	0.0	2.7	6.1	9.7
35	-4.1	-2.1	0.0	3.1	6.8	11.1
40	-4.7	-2.4	0.0	3.4	7.6	12.3
45	-5.3	-2.7	0.0	3.7	8.2	13.4
50	-5.9	-3.0	0.0	4.0	8.8	14.4
55	-6.4	-3.3	0.0	4.3	9.3	15.3

APU fuel included.

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)			
		1500	5000	10000	15000
200	%N1	89.0	92.5		
	KIAS	216	216		
	FF/ENG	9240	9080		
180	%N1	86.1	89.6	94.6	
	KIAS	209	209	209	
	FF/ENG	8370	8250	8320	
160	%N1	83.2	86.5	91.5	96.7
	KIAS	202	202	202	202
	FF/ENG	7540	7460	7480	7690
140	%N1	80.1	83.1	88.2	93.0
	KIAS	194	194	194	194
	FF/ENG	6740	6690	6680	6780

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight**Text****Chapter PI****Section 16**

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer. In addition, sufficient inflight data is provided to complete a flight with the FMC inoperative. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General**FMC Takeoff Speeds**

FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Clearway and Stopway V1 Adjustments

Takeoff speed corrections are to be applied to V1 when using takeoff weights based on the use of clearway and stopway.

Adjust V1 by the amount shown in the table. The adjusted V1 must not exceed VR. If V1 is greater than VR, VR may be increased to equal V1. The resultant V2 will be increased by the same amount that VR was increased.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF Speeds

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver speeds. Using VREF as the basis for the schedule makes it variable as a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assume an engine failure at the critical point during the takeoff.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush depths greater than 13mm (0.5 inches) are not recommended because of possible airplane damage as a result of slush impingement on the airplane structure. The use of assumed temperature for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight is determined as follows:

- (1) Determine the dry field/obstacle limit weight for the takeoff flap setting.
- (2) Enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.
- (3) Adjust field length available for temperature by amount shown on chart.

(4) Enter the V1(MCG) Limit Weight table with the field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

(1) Determine takeoff speeds V1, VR and V2 for actual brake release weight using Takeoff Speeds from the Performance Dispatch chapter or from the FMC.

(2) If V1(MCG) limited, set $V1 = V1(MCG)$. If not limited by V1(MCG) considerations, enter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than V1(MCG), set $V1 = V1(MCG)$.

Slippery Runway

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on reversers operating and a 15 ft screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than the minimum V1 for control on the ground, V1(MCG). It is therefore necessary to compare the adjusted V1 to V1(MCG). To find V1(MCG), enter the V1(MCG) table with airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than V1(MCG), set VR equal to V1(MCG) and determine a new V2 by adding the difference between the normal VR and V1(MCG) to the normal V2. No weight adjustment is required provided that the field length available exceeds the minimum field length required shown in the Field and Climb Limit Weight table.

Go-Around %N1

To find Go-Around %N1 based on normal engine bleed for packs on and anti-ice off, enter the Go-Around %N1 table with airport pressure altitude and reported OAT or TAT and read %N1. %N1 adjustments are shown for engine bleeds for various conditions.

Max Climb %N1

This table shows Max Climb %N1 for a 310/.84 climb speed schedule, normal engine bleed for packs on and anti-ice off. Enter the table with airport pressure altitude and TAT and read %N1. %N1 adjustments are shown for anti-ice operation.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Body attitude and average %N1 information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome may also cause unreliable airspeed/Mach indications. Climb, cruise and descent information is based on the recommended turbulent air penetration speed schedule: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and above; maintain a minimum speed of 15 knots above the minimum maneuvering speed when below 0.82 Mach. This schedule provides ample protection from stall and high speed buffet, while also providing protection from exceeding structural limits.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Control

These tables provide target %N1, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude, .84 Mach approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .84/310/250 descent. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent at .84/310/250

Distance and time for descent are shown for a .84/310/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing Flaps 30 at the outer marker.

Holding

Target %N1, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the FMC optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed for the selected flap setting. Flaps 1 is based on VREF30 + 60 speed schedule. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read %N1, IAS and fuel flow per engine.

Advisory Information

Normal Configuration Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and slippery runways with good, medium, and poor reported braking action. Landing distances for slippery runways are 115% of the actual landing distances.

To use these tables, determine the reference landing distance for the selected braking configuration. Then adjust the reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers to obtain the actual landing distance.

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. If the surface is affected by water, snow, or ice, and the braking action is reported as "good", conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate "poor" data reflects runways covered with wet ice.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" braking action, the airplane may not be able to achieve these deceleration rates. In these cases, runway slope and inoperative reversers influence the stopping distance. Since it cannot be determined quickly when this becomes a factor, it is appropriate to add the effects of slope and inoperative reversers when using the autobrake system.

Non-Normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances and adjustments are provided for dry runways and runways with good, medium, and poor reported braking action.

Enter the table with the applicable non-normal configuration and read the normal approach speed. The reference landing distance is a reference distance from 50 ft above the threshold to stop based on a reference landing weight and speed at sea level, zero wind, and zero slope. Subsequent columns provide corrections for off-reference landing weight, altitude, wind, slope, and speed conditions. Each corrections is independently added to the reference landing distance. Landing distance includes the effects of max manual braking and reverse thrust.

For an engine inoperative autoland, check the rate of climb capability shown in Gear Down Landing Rate of Climb Available tables to ensure adequate climb performance.

Landing Climb Limit Weight

In the event an overweight landing is necessary and the fuel dump system is unavailable, landing climb limits should be checked if a Flaps 30 landing is planned. Enter the table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required. At weights exceeding those shown, plan a Flaps 20 landing.

Recommended Brake Cooling Schedule

Advisory information is provided to assist in avoiding problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Recommended Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind, at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the appropriate Event Adjusted Brake Energy Table (No Reverse Thrust or 2 Engine Reverse) with the reference brake energy per brake and the type of

braking used during landing (Max Manual, Max Auto, or Autobrake). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing. The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Brake Temperature Monitor System (BTMS) indications are also shown. If brake cooling is determined from the BTMS, the hottest brake indication 10 to 15 minutes after the airplane has come to a complete stop, or inflight with gear retracted, may be used to determine recommended cooling schedule by entering at the bottom of the chart. An EICAS advisory message, BRAKE TEMP, will appear when any brake registers 5.0 or higher on the EICAS indication and disappear as the hottest brake cools with an EICAS indication of 3.5. Note that even without an EICAS advisory message, brake cooling is recommended.

Engine Inoperative

Initial Max Continuous %N1

The Initial Max Continuous %N1 setting for use following an engine failure is shown. The table is based on the typical all engine cruise Mach number of .84 to provide a target %N1 setting at the start of driftdown. Once driftdown is established, the Max Continuous %N1 Table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Power setting is based on one engine operating with engine bleed for packs on or off and all anti-ice bleeds off. Enter the table with pressure altitude and IAS or Mach to read %N1.

It is desirable to maintain engine thrust level within the limits of the Max Cruise thrust rating. However, where thrust level in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/Cruise Range Capability

This table shows the range capability from the start of driftdown.

Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to long range cruise speed. Cruise is continued at level off altitude and long range cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and correct for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required. If altitudes other than the level off altitude is used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

Table show the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on LRC speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target %N1, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (KG/HR)				
	GROSS WEIGHT (1000 KG)				
	300	260	220	180	140
43				160	140
39			180	160	145
35		200	190	170	140
31	230	220	195	165	140
25	230	220	195	175	155
20	235	230	205	185	165
15	235	235	215	200	185
10	240	240	230	220	200
5	270	270	255	240	220

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on single engine Long Range Cruise speed and .84/310/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion Table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the off reference fuel corrections table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down Landing Rate of Climb Available

Rate of climb data is provided as guidance information in the event an engine inoperative autoland is planned. The tables show gear down rate of climb available for Flaps 20 and Flaps 30. Enter the table with TAT and pressure altitude to read rate of climb available. Apply adjustments shown to correct for weight.

Gear Down

This section contains performance for airplane operation with the landing gear extended for all phases of flight. The data is based on engine bleeds for normal air conditioning.

Note: The Flight Management Computer System (FMCS) does not contain special provisions for operation with landing gear extended. As a result, the FMCS will generate inaccurate enroute speed schedules, display non-conservative predictions of fuel burn, estimated time of arrival (ETA), maximum altitude, and compute overly shallow descent path. To obtain accurate ETA predictions, gear down cruise speed and altitude should be entered on the CLB and CRZ pages. Gear down cruise speed should also be entered on the DES page and a STEP SIZE of zero should be entered on the PERF INIT or CRZ page. Use of VNAV during descent under these circumstances is not recommended.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

Intentionally
Blank

Performance Inflight**Chapter PI****Table of Contents****Section 20****777-200ER TRENT892 KG FAA**

General	PI.20.1
Maximum Allowable Clearway	PI.20.1
Clearway and Stopway V1 Adjustments	PI.20.1
VREF	PI.20.2
Flap Maneuver Speed	PI.20.3
Slush/Standing Water Takeoff	PI.20.4
Slippery Runway Takeoff	PI.20.8
Minimum Control Speeds	PI.20.12
Go-around EPR	PI.20.13
Max Climb EPR	PI.20.14
Flight With Unreliable Airspeed / Turbulent Air Penetration	PI.20.15
All Engine	PI.21.1
Long Range Cruise Maximum Operating Altitude	PI.21.1
Long Range Cruise Control	PI.21.3
Long Range Cruise Enroute Fuel and Time - Low Altitude	PI.21.4
Long Range Cruise Enroute Fuel and Time - High Altitude	PI.21.5
Long Range Cruise Wind-Altitude Trade	PI.21.6
Descent at .84/310/250 KIAS	PI.21.6
Holding	PI.21.7
Advisory Information	PI.22.1
Normal Configuration Landing Distance	PI.22.1
Non-Normal Configuration Landing Distance	PI.22.4
Landing Climb Limit Weight	PI.22.8
Recommended Brake Cooling Schedule	PI.22.9
Engine Inoperative	PI.23.1
Initial Max Continuous EPR	PI.23.1
Max Continuous EPR	PI.23.2

Driftdown Speed/Level Off Altitude.	PI.23.5
Driftdown/LRC Cruise Range Capability.	PI.23.6
Long Range Cruise Altitude Capability	PI.23.7
Long Range Cruise Control	PI.23.8
Long Range Cruise Diversion Fuel and Time.	PI.23.9
Holding	PI.23.10
Gear Down Landing Rate of Climb Available	PI.23.11
Alternate Mode EEC	PI.24.1
Limit Weight	PI.24.1
Takeoff Speed Adjustment	PI.24.1
Max Takeoff %N1.	PI.24.1
Max Climb %N1	PI.24.2
Max Cruise %N1.	PI.24.2
Go-Around %N1	PI.24.3
Alternate Mode EEC, Engine Inoperative	PI.25.1
Initial Max Continuous %N1	PI.25.1
Max Continuous %N1.	PI.25.2
Gear Down.	PI.26.1
220 KIAS Max Climb EPR.	PI.26.1
Long Range Cruise Altitude Capability	PI.26.1
Long Range Cruise Control	PI.26.2
Long Range Cruise Enroute Fuel and Time	PI.26.3
Descent at VREF30+80.	PI.26.4
Holding	PI.26.5
Gear Down, Engine Inoperative	PI.27.1
Driftdown Speed/Level Off Altitude.	PI.27.1
Long Range Cruise Altitude Capability	PI.27.1
Long Range Cruise Control	PI.27.2
Long Range Cruise Diversion Fuel and Time.	PI.27.3
Holding	PI.27.4

777 Flight Crew Operations Manual

Text	PI.28.1
Introduction	PI.28.1
General	PI.28.1
All Engines	PI.28.4
Advisory Information	PI.28.6
Engine Inoperative	PI.28.8
Alternate Mode EEC	PI.28.11
Alternate Mode EEC, Engine Inoperative	PI.28.12
Gear Down	PI.28.12

Intentionally
Blank

Performance Inflight
General

Chapter PI
Section 20

Maximum Allowable Clearway

FIELD LENGTH (M)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (M)
1500	170
2000	210
2500	250
3000	300
3500	340
4000	380
4500	430

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (M)	NORMAL V1 (KIAS)			
	100	120	140	160
300	-3	-3	-3	-4
200	-3	-3	-3	-3
100	-2	-1	-1	-1
0	0	0	0	0
-100	3	2	2	1
-200	5	4	3	3
-300	6	4	4	4

VREF

Flaps 30

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
300	164	164	165	165	165	166
280	159	159	159	160	160	161
260	154	154	154	154	155	155
240	148	148	148	148	148	149
220	142	142	142	142	142	142
200	135	135	135	135	135	135
180	128	128	128	128	128	128
160	123	121	121	121	121	121
140	123	121	118	116	114	113

Flaps 25

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
300	172	172	173	173	173	173
280	167	167	167	167	167	168
260	162	162	162	162	162	162
240	155	155	156	156	156	156
220	149	149	149	149	149	149
200	142	142	142	142	142	142
180	134	134	134	135	135	135
160	127	127	127	127	127	127
140	123	121	118	118	118	118

Flaps 20

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
300	178	178	179	179	180	181
280	173	173	173	173	174	174
260	167	167	168	168	168	168
240	161	161	161	161	161	162
220	154	154	154	154	154	154
200	147	147	147	147	147	147
180	139	139	139	139	139	139
160	131	131	131	131	131	131
140	123	122	122	123	123	123

Flap Maneuver Speed

FLAP POSITION	MANEUVER SPEED
FLAPS 0	VREF30 + 80
FLAPS 1	VREF30 + 60
FLAPS 5	VREF30 + 40
FLAPS 15	VREF30 + 20
FLAPS 20	VREF30 + 20
FLAPS 25	VREF25
FLAPS 30	VREF30

ADVISORY INFORMATION

Slush/Standing Water Takeoff

Maximum Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.08 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	-32.9	-38.0	-43.0	-38.5	-43.6	-48.7	-50.7	-55.8	-60.9
300	-30.9	-36.0	-41.0	-35.8	-40.8	-45.9	-46.2	-51.3	-56.4
280	-28.6	-33.7	-38.8	-32.8	-37.9	-43.0	-41.7	-46.8	-51.8
260	-26.1	-31.2	-36.3	-29.6	-34.7	-39.8	-37.0	-42.0	-47.1
240	-23.4	-28.5	-33.5	-26.2	-31.3	-36.4	-32.1	-37.2	-42.3
220	-20.4	-25.4	-30.5	-22.6	-27.6	-32.7	-27.2	-32.3	-37.4
200	-17.1	-22.2	-27.3	-18.7	-23.8	-28.9	-22.1	-27.2	-32.3
180	-13.6	-18.6	-23.7	-14.6	-19.7	-24.8	-16.9	-22.0	-27.1
160	-9.8	-14.9	-19.9	-10.3	-15.4	-20.5	-11.6	-16.7	-21.8
140	-5.9	-11.0	-16.1	-5.9	-11.0	-16.1	-6.2	-11.3	-16.4

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1800							109.3		
2000	109.8			123.7			147.5	103.3	
2200	148.5	103.7		162.3	117.5		185.9	141.5	
2400	187.4	142.4		201.6	156.2	111.4	225.4	179.8	135.4
2600	227.7	181.2	136.3	242.3	195.3	150.1	266.0	219.1	173.7
2800	269.7	221.2	175.0	284.4	235.7	189.0	307.9	259.5	212.8
3000	313.5	262.9	214.8	328.3	277.7	229.2	350.8	301.2	253.0
3200	358.6	306.5	256.2	372.5	321.3	270.9		344.0	294.5
3400		351.4	299.4			314.3			337.2
3600			344.3			358.6			

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water adjustment.
2. Adjust field length available by -55 m/+55 m for every 5°C above/below 4°C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slush/Standing Water Takeoff
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	-18	-14	-10	-13	-9	-5	-5	-1	3
300	-19	-15	-11	-14	-10	-6	-4	0	4
280	-20	-16	-12	-16	-12	-8	-5	-1	3
260	-22	-18	-14	-18	-14	-10	-8	-4	0
240	-24	-20	-16	-20	-16	-12	-11	-7	-3
220	-25	-21	-17	-22	-18	-14	-15	-11	-7
200	-26	-22	-18	-23	-19	-15	-18	-14	-10
180	-26	-22	-18	-24	-20	-16	-20	-16	-12
160	-26	-22	-18	-24	-20	-16	-20	-16	-12
140	-26	-22	-18	-24	-20	-16	-20	-16	-12

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slush/Standing Water Takeoff

No Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	-45.2	-51.2	-57.2	-51.6	-57.6	-63.5	-65.3	-71.3	-77.2
300	-42.0	-48.0	-54.0	-47.3	-53.3	-59.3	-58.7	-64.7	-70.7
280	-38.7	-44.7	-50.7	-43.1	-49.1	-55.1	-52.4	-58.4	-64.4
260	-35.2	-41.2	-47.2	-38.8	-44.8	-50.8	-46.3	-52.3	-58.3
240	-31.6	-37.6	-43.6	-34.5	-40.5	-46.4	-40.5	-46.4	-52.4
220	-27.9	-33.9	-39.9	-30.1	-36.1	-42.1	-34.8	-40.8	-46.8
200	-24.0	-30.0	-36.0	-25.7	-31.7	-37.7	-29.4	-35.4	-41.3
180	-20.0	-26.0	-32.0	-21.3	-27.2	-33.2	-24.2	-30.1	-36.1
160	-15.9	-21.9	-27.9	-16.8	-22.8	-28.8	-19.2	-25.1	-31.1
140	-11.7	-17.7	-23.7	-12.3	-18.3	-24.3	-14.2	-20.2	-26.2

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2600							113.4		
2800							158.1	109.0	
3000				132.3			203.1	153.7	104.6
3200	131.8			180.4	127.6		248.9	198.6	149.3
3400	182.1	126.9		229.4	175.6	122.9	295.6	244.4	194.2
3600	233.3	177.2	122.0	279.7	224.6	170.9	343.2	291.0	239.9
3800	286.0	228.3	172.2	331.4	274.7	219.7		338.5	286.4
4000	339.8	280.7	223.2		326.3	269.8			333.8
4200		334.5	275.5			321.2			
4400			329.2						

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water adjustment.
2. Adjust field length available by -75 m/+70 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
300	-30	-24	-18	-23	-17	-11	-8	-2	0
280	-32	-26	-20	-26	-20	-14	-11	-5	0
260	-34	-28	-22	-29	-23	-17	-15	-9	-3
240	-37	-31	-25	-32	-26	-20	-20	-14	-8
220	-39	-33	-27	-35	-29	-23	-25	-19	-13
200	-41	-35	-29	-38	-32	-26	-30	-24	-18
180	-42	-36	-30	-40	-34	-28	-34	-28	-22
160	-43	-37	-31	-41	-35	-29	-37	-31	-25
140	-44	-38	-32	-42	-36	-30	-39	-33	-27

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

**Slippery Runway Takeoff
Maximum Reverse Thrust
Weight Adjustments (1000 KG)**

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	0.0	-1.5	-2.9	-14.9	-16.3	-17.8	-31.3	-32.8	-34.2
300	0.0	-1.5	-2.9	-16.3	-17.7	-19.2	-31.2	-32.7	-34.1
280	-0.4	-1.9	-3.3	-17.1	-18.5	-20.0	-30.6	-32.0	-33.5
260	-1.9	-3.4	-4.8	-17.3	-18.7	-20.2	-29.3	-30.7	-32.2
240	-2.9	-4.4	-5.8	-16.8	-18.3	-19.7	-27.4	-28.8	-30.3
220	-3.4	-4.9	-6.3	-15.7	-17.2	-18.6	-24.9	-26.3	-27.8
200	-3.4	-4.9	-6.3	-14.0	-15.4	-16.9	-21.8	-23.2	-24.7
180	-2.9	-4.4	-5.8	-11.6	-13.1	-14.5	-18.1	-19.5	-21.0
160	-1.9	-3.3	-4.8	-8.6	-10.1	-11.5	-13.8	-15.2	-16.7
140	-0.6	-2.0	-3.5	-5.3	-6.8	-8.2	-9.2	-10.6	-12.1

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1400	104.2								
1600	182.9	135.0							
1800	258.6	212.9	165.8						
2000	330.7	287.1	242.3	146.3	100.0				
2200		358.5	315.2	201.1	154.3	108.0			
2400				257.7	209.3	162.3	114.1		
2600				316.4	266.2	217.5	148.1	104.6	
2800				376.2	325.2	274.7	182.5	138.6	
3000						333.9	218.3	172.7	129.1
3200							256.0	208.1	163.1
3400							295.9	245.2	198.0
3600							338.1	284.5	234.6
3800								326.2	273.3
4000								368.6	314.3

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -30 m/+30 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -40 m/+40 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -60 m/+60 m for every 5°C above/below 4°C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

**Slippery Runway Takeoff
Maximum Reverse Thrust
V1 Adjustments (KIAS)**

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	-3	-1	1	-12	-10	-8	-24	-22	-20
300	-4	-2	0	-14	-12	-10	-27	-25	-23
280	-6	-4	-2	-16	-14	-12	-30	-28	-26
260	-7	-5	-3	-19	-17	-15	-33	-31	-29
240	-9	-7	-5	-21	-19	-17	-36	-34	-32
220	-10	-8	-6	-23	-21	-19	-39	-37	-35
200	-11	-9	-7	-25	-23	-21	-41	-39	-37
180	-12	-10	-8	-26	-24	-22	-43	-41	-39
160	-13	-11	-9	-27	-25	-23	-44	-42	-40
140	-14	-12	-10	-28	-26	-24	-45	-43	-41

- 1. Obtain V1, VR and V2 for the actual weight.
- 2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slippery Runway Takeoff

No Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	-1.4	-2.5	-3.6	-24.7	-25.8	-26.8	-44.3	-45.4	-46.5
300	-4.2	-5.3	-6.4	-25.7	-26.8	-27.9	-42.6	-43.7	-44.8
280	-6.4	-7.4	-8.5	-26.1	-27.2	-28.3	-40.6	-41.7	-42.8
260	-7.9	-9.0	-10.1	-25.9	-27.0	-28.0	-38.4	-39.5	-40.5
240	-8.9	-10.0	-11.0	-24.9	-26.0	-27.1	-35.8	-36.9	-38.0
220	-9.2	-10.3	-11.4	-23.2	-24.3	-25.4	-33.0	-34.1	-35.2
200	-8.9	-10.0	-11.1	-20.9	-22.0	-23.1	-29.8	-30.9	-32.0
180	-8.0	-9.1	-10.2	-17.9	-19.0	-20.1	-26.4	-27.5	-28.6
160	-6.5	-7.6	-8.7	-14.2	-15.3	-16.3	-22.7	-23.8	-24.9
140	-4.8	-5.9	-7.0	-10.2	-11.3	-12.4	-18.9	-20.0	-21.1

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1800	133.8								
2000	263.1	202.4	118.1						
2200	347.5	303.6	253.6						
2400			339.9						
2600				100.3					
2800				218.2	133.5				
3000				307.3	244.4	166.7			
3200					328.1	268.7			
3400						348.8			
3800							119.9		
4000							172.3	111.6	
4200							226.9	164.0	103.3
4400							285.2	218.1	155.7
4600							347.6	275.8	209.3
4800								337.6	266.4
5000									327.7

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -30 m/+30 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -50 m/+45 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -75 m/+70 m for every 5°C above/below 4°C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

**Slippery Runway Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)**

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
300	-7	-3	0	-21	-17	-13	-41	-37	-33
280	-9	-5	-1	-24	-20	-16	-46	-42	-38
260	-11	-7	-3	-27	-23	-19	-50	-46	-42
240	-13	-9	-5	-31	-27	-23	-55	-51	-47
220	-15	-11	-7	-34	-30	-26	-59	-55	-51
200	-17	-13	-9	-37	-33	-29	-63	-59	-55
180	-19	-15	-11	-41	-37	-33	-67	-63	-59
160	-21	-17	-13	-44	-40	-36	-70	-66	-62
140	-23	-19	-15	-47	-43	-39	-72	-68	-64

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

Minimum Control Speeds

V1(MCG), Minimum VR

Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)					
		0		4000		8000	
°C	°F	V1(MCG)	Min VR	V1(MCG)	Min VR	V1(MCG)	Min VR
60	140	109	111	106	108		
50	122	112	114	106	108	101	104
40	104	118	119	109	110	101	104
30	86	122	123	113	114	104	106
20	68	123	123	115	117	107	109
-60	-76	124	124	116	117	109	110

Go-around EPR**Based on engine bleed for packs on and anti-ice off**

REPORTED OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)											
°C	°F	°C	-2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
66	150	70	1.269	1.282	1.284	1.287	1.289	1.290	1.290	1.289	1.287	1.284	1.281	1.278
56	133	60	1.316	1.324	1.328	1.332	1.335	1.337	1.339	1.339	1.338	1.336	1.334	1.332
51	124	55	1.347	1.356	1.356	1.355	1.359	1.361	1.363	1.365	1.364	1.362	1.361	1.359
46	115	50	1.380	1.390	1.392	1.392	1.388	1.387	1.388	1.390	1.389	1.388	1.388	1.387
41	106	45	1.406	1.429	1.428	1.428	1.421	1.416	1.416	1.416	1.415	1.414	1.414	1.414
36	97	40	1.431	1.461	1.461	1.460	1.453	1.446	1.445	1.445	1.444	1.443	1.442	1.441
31	88	35	1.443	1.492	1.491	1.491	1.483	1.477	1.475	1.474	1.473	1.473	1.472	1.471
26	79	30	1.443	1.498	1.511	1.518	1.512	1.505	1.506	1.505	1.504	1.504	1.502	1.502
21	70	25	1.443	1.498	1.511	1.521	1.526	1.531	1.527	1.529	1.528	1.527	1.525	1.525
17	62	20	1.443	1.498	1.511	1.521	1.526	1.531	1.535	1.539	1.545	1.546	1.541	1.539
12	53	15	1.443	1.498	1.511	1.521	1.526	1.531	1.535	1.539	1.547	1.555	1.563	1.561
8 & BELOW	46 & BELOW	12 & BELOW	1.443	1.498	1.511	1.521	1.526	1.531	1.535	1.539	1.547	1.555	1.563	1.571

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)						
	-2000	0	2000	4000	6000	8000	10000
PACKS OFF	0.003	0.003	0.003	0.003	0.004	0.004	0.005
1 PACK ON - 2 BLEED SOURCES	-0.003	-0.003	-0.003	-0.003	-0.004	-0.004	-0.005
1 PACK ON - 1 BLEED SOURCE	-0.003	-0.003	-0.003	-0.003	-0.004	-0.004	-0.005
WING ANTI-ICE ON	-0.002	-0.004	-0.004	-0.005	-0.005	-0.006	-0.006

Max Climb EPR

Based on engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)/SPEED (IAS OR MACH)									
	0	5	10	15	20	25	30	35	40	43
	310	310	310	310	310	310	310	0.84	0.84	0.84
60	1.132	1.122	1.127	1.146	1.166	1.159	1.152	1.174	1.178	1.170
50	1.168	1.161	1.147	1.146	1.166	1.159	1.152	1.174	1.178	1.170
40	1.209	1.205	1.191	1.184	1.173	1.159	1.152	1.174	1.178	1.170
30	1.217	1.253	1.243	1.237	1.228	1.196	1.157	1.174	1.178	1.170
20	1.217	1.253	1.284	1.298	1.292	1.259	1.228	1.191	1.178	1.170
10	1.217	1.253	1.284	1.329	1.364	1.337	1.307	1.273	1.260	1.257
0	1.217	1.253	1.284	1.329	1.374	1.399	1.402	1.367	1.351	1.348
-10	1.217	1.253	1.284	1.329	1.374	1.399	1.434	1.482	1.468	1.465
-15 & BELOW	1.217	1.253	1.284	1.329	1.374	1.399	1.434	1.506	1.521	1.518

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)									
	0	5	10	15	20	25	30	35	40	43
ENGINE ONLY	-0.008	-0.010	-0.015	-0.015	-0.006	-0.005	-0.003	-0.003	-0.004	-0.005
ENGINE & WING*	-0.010	-0.012	-0.018	-0.020	-0.012	-0.012	-0.011	-0.014	-0.017	-0.019
ENGINE & WING**	-0.012	-0.014	-0.021	-0.025	-0.018	-0.019	-0.020	-0.024	-0.029	-0.033

*Wing anti-ice on, packs on.

**Wing anti-ice on, single bleed source and both packs off.

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb**Flaps Up, Set Max Climb Thrust**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82M)	PITCH ATT V/S (FT/MIN)	4.0 1600	3.5 800		
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	4.5 2300	4.5 1600	4.0 1100	4.5 700
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	7.5 3700	7.0 2700	6.5 2100	6.5 1600
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	10.0 4500	8.5 3400	8.0 2700	8.0 2100
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	12.0 5100	10.5 3900	9.5 3100	9.0 2500

Cruise**Flaps Up, Set Thrust for Level Flight**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82 M)	PITCH ATT EPR (Alt Mode %N1)	2.0 1.129 (79.0)	2.5 1.249 (83.4)		
35000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 1.065 (76.7)	2.0 1.118 (78.9)	2.5 1.203 (82.3)	3.0 1.356 (87.2)
30000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 1.021 (73.1)	2.0 1.059 (75.2)	3.0 1.119 (78.2)	3.5 1.196 (81.7)
25000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 0.997 (69.7)	2.0 1.024 (71.7)	3.0 1.067 (74.4)	3.5 1.124 (77.5)
20000 (270 KIAS)	PITCH ATT EPR (Alt Mode %N1)	2.0 0.986 (65.2)	2.5 1.008 (67.7)	3.0 1.039 (70.5)	4.0 1.081 (73.6)
15000 (270 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 0.977 (61.8)	2.5 0.994 (64.0)	3.0 1.018 (66.8)	4.0 1.048 (70.0)

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Descent

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82M)	PITCH ATT V/S (FT/MIN)	-1.0 -2500	-0.5 -2400		
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	-1.5 -2200	-0.5 -1900	0.5 -1900	1.0 -1900
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	-1.0 -1800	0.0 -1600	0.5 -1600	1.5 -1600
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	-1.5 -1700	-0.5 -1500	0.5 -1400	1.5 -1400
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	-1.5 -1500	-0.5 -1400	0.5 -1300	1.5 -1300

Holding

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)			
		160	200	240	280
10000	PITCH ATT	4.0	4.5	5.0	5.0
	EPR	1.004	1.017	1.029	1.040
	(Alt Mode %N1)	(51.3)	(56.8)	(61.7)	(65.9)
5000	PITCH ATT	4.0	4.5	5.0	5.0
	EPR	0.999	1.009	1.019	1.027
	(Alt Mode %N1)	(47.4)	(52.6)	(57.4)	(61.8)
	KIAS	202	216	233	251

Terminal Area (5000 FT)

Set Thrust for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)			
		160	200	240	280
FLAPS 0 (GEAR UP) (VREF30 + 80)	PITCH ATT	4.5	5.0	5.5	5.5
	EPR	1.000	1.010	1.020	1.040
	(Alt Mode %N1)	(48.3)	(53.9)	(58.8)	(63.2)
FLAPS 1 (GEAR UP) (VREF30 + 60)	PITCH ATT	6.0	6.5	7.0	7.0
	EPR	1.020	1.030	1.050	1.060
	(Alt Mode %N1)	(49.5)	(55.4)	(60.9)	(65.4)
FLAPS 5 (GEAR UP) (VREF30 + 40)	PITCH ATT	5.0	5.5	5.5	6.0
	EPR	1.030	1.050	1.070	1.090
	(Alt Mode %N1)	(50.1)	(57.2)	(62.4)	(66.7)
FLAPS 15 (GEAR UP) (VREF30 + 20)	PITCH ATT	6.0	6.0	6.5	6.5
	EPR	1.040	1.060	1.090	1.110
	(Alt Mode %N1)	(51.5)	(58.9)	(64.4)	(68.9)
FLAPS 20 (GEAR DOWN) (VREF30 + 20)	PITCH ATT	4.0	4.5	5.0	5.0
	EPR	1.070	1.100	1.130	1.170
	(Alt Mode %N1)	(58.6)	(65.7)	(70.6)	(74.9)
	KIAS	141	156	169	181

Flight With Unreliable Airspeed / Turbulent Air Penetration
Altitude and/or vertical speed indications may also be unreliable.
Final Approach (1500 FT)
Gear Down, Set Thrust for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)			
		160	200	240	280
FLAPS 20 (VREF20 + 10)	PITCH ATT	1.0	1.5	1.5	1.5
	EPR	1.010	1.010	1.020	1.020
	(Alt Mode %N1)	(34.7)	(40.2)	(45.0)	(49.3)
FLAPS 25 (VREF25 + 10)	KIAS	142	157	172	185
	PITCH ATT	0.0	0.5	0.5	0.5
	EPR	1.030	1.040	1.050	1.070
FLAPS 30 (VREF30 + 10)	(Alt Mode %N1)	(44.1)	(50.7)	(56.2)	(60.6)
	KIAS	138	153	166	179
	PITCH ATT	-0.5	0.0	0.0	0.0
	EPR	1.050	1.070	1.090	1.110
	(Alt Mode %N1)	(50.5)	(56.9)	(62.4)	(66.8)
	KIAS	131	146	159	171

Intentionally
Blank

Performance Inflight**Chapter PI****All Engine****Section 21****Long Range Cruise Maximum Operating Altitude****Max Climb Thrust****ISA + 10°C and Below**

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	-1	33500*	33500*	33500*	33400	31900
290	31100	-3	34300*	34300*	34300*	34100	32700
280	31800	-5	35200*	35200*	35200*	34900	33400
270	32600	-7	36100*	36100*	36100*	35600	34200
260	33400	-8	36800*	36800*	36800*	36400	35000
250	34200	-10	37600*	37600*	37600*	37200	35800
240	35100	-12	38400*	38400*	38400*	38100	36600
230	36000	-14	39300*	39300*	39300*	39000	37500
220	36900	-14	40200*	40200*	40200*	39900	38500
210	37900	-14	41100*	41100*	41100*	40900	39400
200	38900	-14	42100*	42100*	42100*	41900	40400
190	40000	-14	43000	43000	43000	42900	41500
180	41100	-14	43000	43000	43000	43000	42600
170	42300	-14	43000	43000	43000	43000	43000
160	43000	-14	43000	43000	43000	43000	43000
150	43000	-14	43000	43000	43000	43000	43000
140	43000	-14	43000	43000	43000	43000	43000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	4	32500*	32500*	32500*	32500*	31900
290	31100	3	33400*	33400*	33400*	33400*	32700
280	31800	1	34300*	34300*	34300*	34300*	33400
270	32600	-1	35200*	35200*	35200*	35200*	34200
260	33400	-3	36100*	36100*	36100*	36100*	35000
250	34200	-5	36900*	36900*	36900*	36900*	35800
240	35100	-7	37700*	37700*	37700*	37700*	36600
230	36000	-9	38600*	38600*	38600*	38600*	37500
220	36900	-9	39500*	39500*	39500*	39500*	38500
210	37900	-9	40400*	40400*	40400*	40400*	39400
200	38900	-9	41400*	41400*	41400*	41400*	40400
190	40000	-9	42400*	42400*	42400*	42400*	41500
180	41100	-9	43000	43000	43000	43000	42600
170	42300	-9	43000	43000	43000	43000	43000
160	43000	-9	43000	43000	43000	43000	43000
150	43000	-9	43000	43000	43000	43000	43000
140	43000	-9	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Maximum Operating Altitude

Max Climb Thrust

ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	10	31100*	31100*	31100*	31100*	31100*
290	31100	8	32100*	32100*	32100*	32100*	32100*
280	31800	7	33100*	33100*	33100*	33100*	33100*
270	32600	5	34100*	34100*	34100*	34100*	34100*
260	33400	3	35100*	35100*	35100*	35100*	35000
250	34200	1	36100*	36100*	36100*	36100*	35800
240	35100	-1	36800*	36800*	36800*	36800*	36600
230	36000	-3	37700*	37700*	37700*	37700*	37500
220	36900	-3	38600*	38600*	38600*	38600*	38500
210	37900	-3	39500*	39500*	39500*	39500*	39400
200	38900	-3	40500*	40500*	40500*	40500*	40400
190	40000	-3	41500*	41500*	41500*	41500*	41500
180	41100	-3	42600*	42600*	42600*	42600*	42600
170	42300	-3	43000	43000	43000	43000	43000
160	43000	-3	43000	43000	43000	43000	43000
150	43000	-3	43000	43000	43000	43000	43000
140	43000	-3	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		25	27	29	31	33	35	37	39	41	43
300	EPR	1.106	1.131	1.168	1.229	1.326					
	MACH	.772	.802	.834	.840	.838					
	KIAS	325	325	325	314	300					
	FF/ENG	4499	4533	4621	4641	4746					
280	EPR	1.083	1.106	1.135	1.182	1.247	1.365				
	MACH	.772	.802	.834	.841	.839	.838				
	KIAS	325	325	325	314	300	287				
	FF/ENG	4289	4321	4375	4343	4305	4482				
260	EPR	1.064	1.085	1.111	1.142	1.193	1.266	1.412			
	MACH	.770	.796	.821	.838	.841	.839	.839			
	KIAS	324	322	319	313	301	287	274			
	FF/ENG	4095	4094	4085	4045	3988	3985	4261			
240	EPR	1.047	1.066	1.088	1.115	1.148	1.201	1.284			
	MACH	.746	.772	.799	.823	.839	.840	.839			
	KIAS	313	312	310	307	300	287	274			
	FF/ENG	3762	3759	3758	3747	3705	3645	3691			
220	EPR	1.033	1.048	1.068	1.090	1.118	1.153	1.209	1.297		
	MACH	.721	.746	.773	.800	.825	.840	.840	.839		
	KIAS	302	300	299	297	294	287	274	261		
	FF/ENG	3437	3429	3427	3425	3413	3372	3337	3416		
200	EPR	1.021	1.033	1.048	1.068	1.090	1.118	1.155	1.212	1.300	
	MACH	.695	.719	.745	.772	.799	.825	.840	.840	.839	
	KIAS	290	289	287	286	284	281	274	262	249	
	FF/ENG	3123	3108	3100	3098	3095	3085	3065	3054	3127	
180	EPR	1.009	1.020	1.032	1.047	1.066	1.089	1.117	1.153	1.208	1.293
	MACH	.667	.690	.714	.740	.768	.796	.822	.839	.840	.839
	KIAS	278	276	275	273	272	270	268	262	250	238
	FF/ENG	2881	2853	2834	2775	2772	2770	2779	2784	2773	2826
160	EPR	1.000	1.008	1.018	1.030	1.044	1.063	1.085	1.114	1.147	1.199
	MACH	.636	.659	.682	.707	.733	.761	.790	.817	.837	.841
	KIAS	264	263	261	260	259	257	256	254	249	239
	FF/ENG	2589	2558	2532	2463	2454	2449	2464	2494	2505	2500

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitude
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
283	262	243	226	213	200	191	182	174	167	161
567	524	485	453	425	400	382	366	351	337	324
851	786	729	680	638	600	573	549	526	505	486
1136	1050	974	908	851	800	764	732	701	673	648
1423	1314	1218	1136	1064	1000	956	914	876	842	810
1711	1580	1463	1364	1277	1200	1147	1097	1052	1010	972
2000	1846	1709	1592	1491	1400	1337	1279	1226	1177	1133
2290	2112	1954	1820	1704	1600	1528	1462	1401	1345	1295
2581	2380	2201	2049	1918	1800	1720	1645	1576	1513	1456
2874	2649	2449	2279	2132	2000	1910	1827	1751	1680	1617

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	3.6	0:39	3.1	0:37	2.6	0:36	2.3	0:35	2.0	0:34
400	7.6	1:14	6.8	1:11	5.9	1:06	5.3	1:04	4.8	1:01
600	11.5	1:50	10.5	1:44	9.1	1:37	8.4	1:33	7.6	1:29
800	15.4	2:26	14.2	2:18	12.4	2:09	11.4	2:03	10.4	1:57
1000	19.4	3:02	17.9	2:53	15.6	2:40	14.4	2:33	13.2	2:26
1200	23.3	3:38	21.5	3:27	18.8	3:12	17.4	3:03	16.0	2:54
1400	27.1	4:15	25.1	4:02	21.9	3:44	20.3	3:33	18.7	3:23
1600	31.0	4:53	28.7	4:37	25.1	4:16	23.2	4:03	21.5	3:51
1800	34.7	5:30	32.2	5:13	28.2	4:48	26.1	4:34	24.2	4:20
2000	38.5	6:08	35.7	5:49	31.2	5:21	29.0	5:04	26.9	4:49

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)							
	160	180	200	220	240	260	280	300
5	-0.3	-0.2	0.0	0.2	0.5	0.7	1.0	1.2
10	-0.7	-0.4	0.0	0.5	1.1	1.6	2.2	2.7
15	-1.1	-0.6	0.0	0.8	1.7	2.5	3.4	4.2
20	-1.6	-0.8	0.0	1.1	2.2	3.4	4.5	5.7
25	-2.0	-1.0	0.0	1.4	2.8	4.2	5.7	7.1
30	-2.5	-1.2	0.0	1.6	3.3	5.0	6.7	8.5
35	-3.0	-1.4	0.0	1.8	3.8	5.7	7.8	9.9
40	-3.4	-1.7	0.0	2.0	4.2	6.5	8.8	11.3

Long Range Cruise Enroute Fuel and Time - High Altitude
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
525	495	467	442	420	400	383	368	353	340	328
1045	985	931	883	840	800	767	737	709	683	659
1566	1477	1396	1324	1259	1200	1152	1107	1065	1026	991
2089	1970	1862	1766	1679	1600	1536	1476	1420	1369	1322
2614	2465	2329	2208	2100	2000	1920	1845	1776	1712	1653
3141	2961	2797	2651	2520	2400	2304	2215	2131	2054	1984
3670	3458	3265	3094	2941	2800	2688	2584	2486	2397	2315
4201	3957	3735	3538	3362	3200	3072	2952	2842	2739	2645
4734	4457	4206	3983	3783	3600	3456	3321	3196	3081	2975
5269	4959	4677	4428	4205	4000	3840	3690	3551	3423	3305
5806	5463	5151	4874	4627	4400	4223	4058	3905	3764	3634
6346	5968	5625	5321	5049	4800	4607	4426	4259	4104	3962
6888	6475	6100	5768	5471	5200	4990	4794	4612	4444	4290
7433	6984	6576	6216	5894	5600	5373	5161	4964	4783	4617
7981	7495	7054	6665	6317	6000	5756	5528	5316	5121	4943
8532	8008	7533	7114	6741	6400	6138	5894	5668	5460	5269
9086	8523	8013	7565	7165	6800	6521	6261	6020	5797	5594
9643	9041	8496	8017	7589	7200	6903	6627	6370	6134	5918
10204	9561	8980	8469	8014	7600	7285	6992	6721	6470	6241
10769	10084	9465	8922	8440	8000	7667	7357	7070	6806	6564

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37 & ABOVE	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
400	4.7	1:01	4.5	0:60	4.4	0:59	4.2	0:58	4.1	0:57
800	10.2	1:56	9.9	1:53	9.6	1:51	9.3	1:49	9.0	1:47
1200	15.6	2:52	15.1	2:48	14.7	2:44	14.3	2:40	13.9	2:38
1600	21.0	3:49	20.3	3:43	19.7	3:37	19.2	3:32	18.7	3:28
2000	26.4	4:45	25.4	4:38	24.7	4:31	24.0	4:24	23.5	4:19
2400	31.6	5:44	30.3	5:35	29.5	5:26	28.7	5:18	28.1	5:10
2800	36.7	6:42	35.3	6:31	34.3	6:21	33.4	6:11	32.6	6:02
3200	41.8	7:41	40.1	7:29	39.0	7:16	38.0	7:05	37.1	6:54
3600	46.7	8:41	44.9	8:27	43.6	8:13	42.4	7:60	41.5	7:47
4000	51.7	9:42	49.6	9:25	48.2	9:09	46.9	8:55	45.8	8:40
4400	56.4	10:44	54.2	10:25	52.7	10:08	51.3	9:51	50.1	9:35
4800	61.2	11:46	58.8	11:25	57.2	11:06	55.6	10:47	54.4	10:29
5200	65.8	12:49	63.3	12:26	61.6	12:05	59.9	11:45	58.5	11:24
5600	70.4	13:53	67.8	13:28	65.8	13:05	64.1	12:43	62.6	12:20
6000	74.9	14:57	72.2	14:30	70.1	14:05	68.2	13:41	66.7	13:16
6400	79.4	16:04	76.4	15:34	74.2	15:07	72.2	14:41	70.6	14:14
6800	83.9	17:11	80.7	16:39	78.3	16:09	76.2	15:40	74.4	15:11
7200	88.3	18:19	84.9	17:44	82.4	17:12	80.1	16:41	78.3	16:10
7600	92.6	19:28	89.0	18:50	86.3	18:16	83.9	17:43	82.0	17:09
8000	96.9	20:38	93.2	19:57	90.3	19:20	87.8	18:45	85.7	18:09

**Long Range Cruise Enroute Fuel and Time - High Altitude
Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)							
	160	180	200	220	240	260	280	300
10	-1.1	-0.5	0.0	0.6	2.1	6.3	12.7	21.3
20	-2.1	-1.1	0.0	1.1	4.0	9.5	17.3	27.5
30	-3.1	-1.6	0.0	1.7	5.7	12.3	21.4	32.9
40	-4.2	-2.1	0.0	2.4	7.4	14.9	24.9	37.5
50	-5.3	-2.7	0.0	3.1	8.8	17.1	28.0	41.4
60	-6.4	-3.2	0.0	3.8	10.2	19.1	30.5	44.5
70	-7.5	-3.8	0.0	4.5	11.4	20.7	32.6	46.8
80	-8.6	-4.3	0.0	5.1	12.4	22.1	34.1	48.4
90	-9.7	-4.9	0.0	5.6	13.4	23.2	35.1	49.2
100	-10.9	-5.4	0.0	6.1	14.1	24.0	35.7	49.2

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)						
	260	240	220	200	180	160	140
43				43	10	0	7
41			42	12	0	3	19
39		38	12	0	2	14	33
37	32	10	0	1	11	28	49
35	7	0	1	10	24	43	64
33	0	2	10	23	39	58	78
31	3	10	22	37	54	72	91
29	12	23	36	52	68	85	102
27	24	37	51	66	81	97	112
25	38	51	65	79	93	107	121

The above wind factor table is for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. Read wind factors for present and new altitudes from table.
2. Determine difference (new altitude wind factor minus present altitude wind factor);
This difference may be negative or positive.
3. Break-even wind at new altitude is present altitude wind plus difference from step 2.

Descent at .84/310/250 KIAS

PRESSURE ALT (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	93	100	107	114	119	124	130	136	142	148
TIME (MINUTES)	19	20	21	22	23	23	24	25	25	26

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
300	EPR	1.023	1.031	1.047	1.059	1.075	1.123	1.198			
	KIAS	260	260	262	277	302	306	311			
	FF/ENG	4350	4320	4190	4230	4440	4530	4710			
280	EPR	1.020	1.027	1.040	1.055	1.067	1.108	1.169	1.356		
	KIAS	251	251	253	261	286	295	299	279		
	FF/ENG	4060	4020	3890	3890	4060	4180	4300	4550		
260	EPR	1.017	1.023	1.034	1.052	1.063	1.092	1.145	1.265		
	KIAS	242	242	243	246	266	283	287	279		
	FF/ENG	3770	3720	3690	3580	3740	3830	3920	4060		
240	EPR	1.014	1.019	1.029	1.045	1.059	1.074	1.124	1.203		
	KIAS	232	233	234	235	247	272	275	279		
	FF/ENG	3560	3510	3460	3350	3380	3490	3560	3710		
220	EPR	1.011	1.015	1.024	1.037	1.055	1.066	1.105	1.167	1.357	
	KIAS	222	223	224	224	230	251	262	266	249	
	FF/ENG	3280	3230	3170	3140	3050	3160	3220	3310	3590	
200	EPR	1.006	1.010	1.018	1.030	1.048	1.061	1.084	1.138	1.249	
	KIAS	215	215	215	215	215	229	249	253	249	
	FF/ENG	3010	2960	2890	2850	2760	2800	2880	2950	3130	
180	EPR	1.002	1.005	1.011	1.020	1.034	1.056	1.068	1.113	1.186	1.289
	KIAS	208	208	208	208	208	209	230	239	242	232
	FF/ENG	2810	2690	2630	2580	2550	2470	2570	2600	2770	2870
160	EPR	0.997	0.999	1.003	1.009	1.021	1.038	1.062	1.088	1.147	1.202
	KIAS	203	203	203	203	203	203	206	224	227	229
	FF/ENG	2570	2510	2390	2330	2290	2270	2220	2320	2440	2560
140	EPR	0.991	0.992	0.994	0.998	1.006	1.017	1.035	1.068	1.115	1.154
	KIAS	203	203	203	203	203	203	203	203	211	213
	FF/ENG	2400	2330	2250	2130	2090	2050	1980	1980	2100	2170

This table includes 5% additional fuel for holding in a racetrack pattern.

Holding Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
300	EPR	1.060	1.073	1.100	1.140	1.199
	KIAS	224	224	224	224	224
	FF/ENG	4700	4560	4540	4560	4600
280	EPR	1.052	1.064	1.086	1.121	1.172
	KIAS	219	219	219	219	219
	FF/ENG	4370	4330	4200	4210	4230
260	EPR	1.044	1.054	1.073	1.103	1.147
	KIAS	214	214	214	214	214
	FF/ENG	4040	3990	3860	3860	3940
240	EPR	1.037	1.046	1.062	1.087	1.125
	KIAS	208	208	208	208	208
	FF/ENG	3720	3680	3630	3590	3600
220	EPR	1.030	1.038	1.052	1.072	1.105
	KIAS	202	202	202	202	202
	FF/ENG	3480	3440	3380	3270	3270
200	EPR	1.024	1.030	1.043	1.059	1.085
	KIAS	195	195	195	195	195
	FF/ENG	3180	3130	3080	3040	2950
180	EPR	1.018	1.023	1.034	1.047	1.067
	KIAS	188	188	188	188	188
	FF/ENG	2950	2840	2780	2730	2640
160	EPR	1.012	1.016	1.023	1.034	1.050
	KIAS	183	183	183	183	183
	FF/ENG	2680	2620	2500	2450	2420
140	EPR	1.005	1.008	1.013	1.021	1.033
	KIAS	183	183	183	183	183
	FF/ENG	2470	2400	2280	2230	2180

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight

Advisory Information

Chapter PI

Section 22

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 30

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WT	PER 5000 KG ABOVE / BELOW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN / UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF30	ONE REV	NO REV

Dry Runway

MAX MANUAL	885	+25/-5	20	-35/+125	+10/-10	+20/-20	35	10	25
AUTOBRAKE MAX	1180	+20/-5	25	-50/+175	0/0	+30/-30	65	0	0
AUTOBRAKE 4	1455	+25/-10	40	-70/+245	0/-5	+40/-40	80	0	0
AUTOBRAKE 3	1735	+30/-10	45	-90/+305	+10/-10	+50/-50	95	0	0
AUTOBRAKE 2	1940	+40/-20	55	-100/+355	+15/-30	+55/-55	95	5	5
AUTOBRAKE 1	2090	+45/-25	65	-115/+395	+40/-55	+60/-60	85	90	90

Good Reported Braking Action

MAX MANUAL	1220	+20/-10	30	-60/+215	+30/-25	+30/-30	50	55	125
AUTOBRAKE MAX	1300	+25/-10	35	-65/+225	+25/-20	+30/-30	60	55	130
AUTOBRAKE 4	1460	+25/-10	40	-70/+250	+10/-5	+40/-40	80	5	25
AUTOBRAKE 3	1735	+30/-10	45	-90/+305	+10/-10	+50/-50	95	0	0
AUTOBRAKE 2	1940	+40/-20	55	-100/+355	+15/-30	+55/-55	95	5	5
AUTOBRAKE 1	2090	+45/-25	65	-115/+395	+40/-55	+60/-60	85	90	90

Medium Reported Braking Action

MAX MANUAL	1640	+35/-20	50	-95/+350	+75/-60	+40/-40	65	160	390
AUTOBRAKE MAX	1650	+35/-15	50	-95/+355	+70/-50	+40/-40	75	150	385
AUTOBRAKE 4	1670	+35/-15	50	-95/+355	+75/-55	+45/-45	70	165	400
AUTOBRAKE 3	1825	+35/-15	50	-105/+375	+50/-30	+50/-50	95	80	285
AUTOBRAKE 2	1990	+40/-20	55	-110/+400	+45/-45	+55/-55	95	45	180
AUTOBRAKE 1	2115	+45/-25	65	-120/+425	+65/-65	+60/-60	85	110	185

Poor Reported Braking Action

MAX MANUAL	2100	+45/-30	70	-140/+550	+175/-115	+55/-55	75	345	945
AUTOBRAKE MAX	2105	+50/-30	70	-140/+550	+175/-115	+55/-55	75	345	945
AUTOBRAKE 4	2120	+50/-30	70	-140/+550	+175/-120	+55/-55	75	350	955
AUTOBRAKE 3	2140	+50/-25	70	-140/+555	+175/-100	+55/-55	85	345	950
AUTOBRAKE 2	2225	+50/-30	70	-145/+565	+150/-100	+60/-60	95	260	860
AUTOBRAKE 1	2300	+50/-30	75	-150/+580	+155/-110	+60/-60	85	285	800

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 60 m.

For autobrake and manual speedbrakes, increase reference landing distance by 50 m.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Normal Configuration Landing Distance****Flaps 25**

	LANDING DISTANCE AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	200000 KG LANDING WT	PER 5000 KG ABOVE/ BELOW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN / UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF25	ONE REV NO REV

Dry Runway

MAX MANUAL	925	+25/-10	20	-35/+130	+10/-10	+20/-20	35	15	30
AUTOBRAKE MAX	1260	+20/-15	30	-55/+180	0/0	+30/-30	65	0	0
AUTOBRAKE 4	1565	+30/-20	40	-75/+255	0/-5	+40/-40	85	0	0
AUTOBRAKE 3	1875	+35/-25	50	-95/+315	+10/-10	+55/-55	100	0	0
AUTOBRAKE 2	2080	+45/-35	60	-105/+365	+25/-40	+60/-60	90	30	30
AUTOBRAKE 1	2215	+50/-40	70	-120/+410	+50/-60	+60/-60	85	145	150

Good Reported Braking Action

MAX MANUAL	1280	+25/-15	35	-60/+220	+30/-25	+30/-30	50	65	145
AUTOBRAKE MAX	1370	+25/-15	35	-65/+230	+25/-25	+35/-35	60	70	155
AUTOBRAKE 4	1570	+30/-20	40	-75/+260	+10/-5	+40/-40	85	5	25
AUTOBRAKE 3	1875	+35/-25	50	-95/+315	+10/-10	+55/-55	100	0	0
AUTOBRAKE 2	2080	+45/-35	60	-105/+365	+25/-40	+60/-60	90	30	30
AUTOBRAKE 1	2215	+50/-40	70	-120/+410	+50/-60	+60/-60	85	145	150

Medium Reported Braking Action

MAX MANUAL	1720	+35/-30	50	-95/+360	+75/-60	+45/-45	65	180	460
AUTOBRAKE MAX	1735	+35/-25	50	-95/+360	+70/-55	+45/-45	75	175	450
AUTOBRAKE 4	1760	+35/-25	50	-100/+360	+75/-50	+45/-45	75	180	465
AUTOBRAKE 3	1960	+40/-25	55	-105/+390	+50/-35	+55/-55	100	80	305
AUTOBRAKE 2	2130	+45/-35	65	-115/+415	+55/-55	+60/-60	90	70	215
AUTOBRAKE 1	2240	+50/-40	70	-125/+435	+75/-70	+65/-65	85	170	250

Poor Reported Braking Action

MAX MANUAL	2200	+50/-40	70	-145/+560	+175/-115	+55/-55	75	390	1105
AUTOBRAKE MAX	2205	+50/-40	75	-145/+560	+180/-120	+60/-60	75	390	1105
AUTOBRAKE 4	2220	+50/-40	75	-145/+560	+175/-120	+60/-60	75	395	1115
AUTOBRAKE 3	2255	+50/-35	75	-145/+565	+170/-95	+60/-60	95	370	1095
AUTOBRAKE 2	2360	+50/-40	75	-150/+580	+155/-105	+65/-65	90	290	985
AUTOBRAKE 1	2430	+55/-45	80	-155/+590	+165/-115	+65/-65	85	345	935

Reference distance is for sea level, standard day, no wind or slope, VREF25 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 60 m.

For autobrake and manual speedbrakes, increase reference landing distance by 50 m.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Normal Configuration Landing Distance****Flaps 20**

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WT	PER 5000 KG ABOVE / BELOW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN / UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF20	ONE REV	NO REV

Dry Runway

MAX MANUAL	965	+30/-15	20	-40/+130	+10/-10	+20/-20	35	15	35
AUTOBRAKE MAX	1320	+25/-20	30	-55/+185	0/0	+30/-30	65	0	0
AUTOBRAKE 4	1655	+30/-30	45	-75/+260	0/-5	+45/-45	90	0	0
AUTOBRAKE 3	1990	+40/-35	55	-95/+330	+5/-10	+55/-55	105	0	0
AUTOBRAKE 2	2215	+45/-45	65	-110/+380	+20/-40	+65/-65	100	30	30
AUTOBRAKE 1	2365	+55/-50	75	-125/+425	+50/-65	+65/-65	95	145	150

Good Reported Braking Action

MAX MANUAL	1345	+25/-20	35	-65/+225	+35/-30	+30/-35	50	75	170
AUTOBRAKE MAX	1435	+25/-25	40	-65/+235	+30/-25	+35/-35	60	75	180
AUTOBRAKE 4	1660	+30/-30	45	-80/+270	+5/-5	+45/-45	90	5	30
AUTOBRAKE 3	1990	+40/-35	55	-95/+330	+5/-10	+55/-55	105	0	0
AUTOBRAKE 2	2215	+45/-45	65	-110/+380	+20/-40	+65/-65	100	30	30
AUTOBRAKE 1	2365	+55/-50	75	-125/+425	+50/-65	+65/-65	95	145	150

Medium Reported Braking Action

MAX MANUAL	1820	+40/-35	55	-100/+370	+80/-65	+45/-45	65	210	540
AUTOBRAKE MAX	1830	+40/-35	55	-100/+370	+80/-60	+50/-50	75	200	530
AUTOBRAKE 4	1865	+40/-35	55	-100/+370	+75/-55	+50/-50	80	205	545
AUTOBRAKE 3	2080	+40/-35	60	-110/+400	+45/-35	+55/-60	105	90	370
AUTOBRAKE 2	2265	+45/-45	70	-120/+425	+55/-55	+65/-65	100	70	250
AUTOBRAKE 1	2390	+55/-50	80	-130/+450	+75/-75	+70/-70	95	170	265

Poor Reported Braking Action

MAX MANUAL	2335	+55/-50	80	-150/+575	+185/-125	+60/-60	75	450	1305
AUTOBRAKE MAX	2340	+55/-50	80	-150/+575	+190/-125	+60/-60	75	450	1310
AUTOBRAKE 4	2355	+55/-50	80	-150/+575	+185/-125	+60/-60	80	455	1320
AUTOBRAKE 3	2400	+55/-50	80	-150/+580	+175/-105	+65/-65	95	425	1295
AUTOBRAKE 2	2505	+55/-50	80	-155/+595	+160/-110	+70/-70	100	330	1185
AUTOBRAKE 1	2585	+60/-55	85	-160/+605	+170/-125	+70/-70	95	370	1100

Reference distance is for sea level, standard day, no wind or slope, VREF20 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 65 m.

For autobrake and manual speedbrakes, increase reference landing distance by 50 m.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****Dry Runway**

		LANDING DISTANCES AND ADJUSTMENTS (M)								
EICAS MESSAGE	VREF	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
		180000 KG LDG WT	PER 5000 KG ABV/BLW 180000 KG	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	1580	35/-35	50	-90/355	75/-55	20/-20	120	170	435
ANTISKID (FLAPS 30)	VREF30	1505	35/-35	45	-90/345	70/-50	20/-20	120	145	370
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	915	25/-15	20	-35/130	10/-10	10/-10	75	-	20
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	835	25/-15	20	-35/125	10/-10	10/-10	70	-	10
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	1060	40/-15	25	-45/150	15/-10	15/-15	75	30	65
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	960	25/-15	20	-35/135	10/-10	10/-10	65	20	45
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	905	25/-15	20	-35/130	10/-10	10/-10	65	15	35
FLAPS PRIMARY FAIL	VREF20	1015	25/-15	20	-40/140	10/-10	10/-10	85	20	45
FLAP/SLAT CONTROL	VREF20	900	25/-15	20	-35/130	10/-10	10/-10	65	15	35
FLIGHT CONTROL MODE	VREF20	1040	25/-15	25	-45/145	10/-10	10/-10	90	20	45
HYD PRESS SYS C	VREF20	1015	25/-15	20	-40/140	10/-10	10/-10	85	20	45
HYD PRESS SYS L+C	VREF30+20	1165	25/-20	25	-45/160	20/-15	15/-15	110	-	35
HYD PRESS SYS L+R	VREF30+20	1255	25/-20	30	-55/190	30/-25	20/-20	130	-	-
HYD PRESS SYS R+C	VREF30+20	1440	25/-25	35	-65/220	35/-30	20/-20	150	-	90
HYD PRESS SYS L (FLAPS 25)	VREF25	920	25/-15	20	-40/135	10/-10	10/-10	80	-	20
HYD PRESS SYS L (FLAPS 30)	VREF30	880	25/-15	20	-35/130	10/-10	10/-10	80	-	15
HYD PRESS SYS R (FLAPS 25)	VREF25	1015	20/-15	25	-45/160	20/-15	10/-10	95	-	30
HYD PRESS SYS R (FLAPS 30)	VREF30	960	15/-15	20	-45/155	20/-15	10/-10	90	-	25
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	1055	35/-15	25	-45/145	10/-10	15/-15	65	25	60
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	935	25/-15	20	-35/135	10/-10	10/-10	65	20	40
PRI FLIGHT COMPUTERS	VREF20	1040	25/-15	25	-45/145	10/-10	10/-10	90	20	45
SLATS DRIVE	VREF30+30	1050	25/-15	25	-40/140	10/-10	10/-10	75	25	50
STABILIZER	VREF30+20	975	25/-15	20	-35/135	10/-10	10/-10	70	20	45

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (305 meters air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
Good Reported Braking Action

		LANDING DISTANCES AND ADJUSTMENTS (M)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	180000 KG LDG WT	PER 5000 KG ABV/BLW 180000 KG	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	1580	35/-35	50	-90/355	75/-55	20/-20	120	170	435
ANTISKID (FLAPS 30)	VREF30	1505	35/-35	45	-90/345	70/-50	20/-20	120	145	370
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	1295	25/-25	35	-65/225	35/-30	20/-20	105	-	85
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	1165	25/-25	30	-60/220	30/-25	15/-15	100	-	60
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	1490	25/-25	45	-65/240	35/-30	20/-20	95	105	255
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	1335	25/-25	35	-60/225	30/-25	20/-20	100	85	205
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	1245	25/-25	35	-60/220	30/-25	15/-15	95	65	160
FLAPS PRIMARY FAIL	VREF20	1375	25/-25	35	-65/235	35/-30	20/-20	115	80	195
FLAP/SLAT CONTROL	VREF20	1235	25/-25	35	-60/215	30/-25	15/-15	95	65	150
FLIGHT CONTROL MODE	VREF20	1415	30/-30	35	-65/240	35/-30	20/-20	125	90	220
HYD PRESS SYS C	VREF20	1375	25/-25	35	-65/235	35/-30	20/-20	115	80	195
HYD PRESS SYS L+C	VREF30+20	1670	30/-30	50	-80/275	55/-45	25/-25	155	-	165
HYD PRESS SYS L+R	VREF30+20	1740	35/-35	50	-85/300	75/-60	25/-25	175	-	-
HYD PRESS SYS R+C	VREF30+20	1710	35/-35	50	-80/285	60/-50	25/-25	170	-	180
HYD PRESS SYS L (FLAPS 25)	VREF25	1320	25/-25	35	-65/240	45/-35	20/-20	120	-	100
HYD PRESS SYS L (FLAPS 30)	VREF30	1250	25/-25	35	-65/240	40/-35	20/-20	120	-	80
HYD PRESS SYS R (FLAPS 25)	VREF25	1320	25/-25	35	-65/240	45/-35	20/-20	120	-	100
HYD PRESS SYS R (FLAPS 30)	VREF30	1240	25/-25	35	-65/235	40/-30	20/-20	120	-	80
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	1475	25/-25	40	-65/230	30/-25	20/-20	90	95	225
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	1290	25/-25	35	-60/220	30/-25	20/-20	90	70	160
PRI FLIGHT COMPUTERS	VREF20	1415	30/-30	35	-65/240	35/-30	20/-20	125	90	220
SLATS DRIVE	VREF30+30	1450	25/-25	40	-65/240	35/-30	20/-20	100	90	215
STABILIZER	VREF30+20	1345	25/-25	35	-60/230	35/-25	20/-20	100	80	190

Actual (unfactored) distances are shown.
Includes distances from 50 ft above threshold (305 meters air distance).
Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****Medium Reported Braking Action**

		LANDING DISTANCES AND ADJUSTMENTS (M)								
EICAS MESSAGE	VREF	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
		180000 KG LDG WT	PER 5000 KG ABV/BLW 180000 KG	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	2000	50/-45	65	-135/560	175/-105	25/-25	135	365	1050
ANTISKID (FLAPS 30)	VREF30	1915	50/-45	65	-130/550	175/-105	25/-25	135	325	900
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	1815	45/-45	55	-105/385	100/-75	25/-25	140	-	290
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	1610	35/-35	45	-100/370	85/-65	25/-25	130	-	205
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	2015	45/-45	65	-105/390	80/-65	30/-30	125	295	825
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	1785	40/-40	55	-95/365	75/-60	25/-25	120	240	650
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	1665	40/-40	50	-90/360	75/-60	25/-25	120	195	510
FLAPS PRIMARY FAIL	VREF20	1815	45/-45	55	-100/380	80/-65	25/-25	145	230	615
FLAP/SLAT CONTROL	VREF20	1645	35/-35	50	-90/355	70/-55	25/-25	120	185	485
FLIGHT CONTROL MODE	VREF20	1870	45/-45	60	-100/385	90/-65	25/-25	155	255	695
HYD PRESS SYS C	VREF20	1815	45/-45	55	-100/380	80/-65	25/-25	145	230	615
HYD PRESS SYS L+C	VREF30+20	2345	50/-50	80	-130/470	145/-105	35/-35	200	-	525
HYD PRESS SYS L+R	VREF30+20	2730	55/-55	80	-155/560	265/-170	45/-45	245	-	-
HYD PRESS SYS R+C	VREF30+20	2395	55/-50	75	-130/480	160/-115	35/-35	215	-	565
HYD PRESS SYS L (FLAPS 25)	VREF25	1860	45/-40	60	-110/420	115/-80	25/-25	155	-	325
HYD PRESS SYS L (FLAPS 30)	VREF30	1770	40/-40	50	-105/410	115/-80	25/-25	160	-	275
HYD PRESS SYS R (FLAPS 25)	VREF25	1850	45/-40	55	-110/420	115/-80	25/-25	155	-	315
HYD PRESS SYS R (FLAPS 30)	VREF30	1730	40/-35	50	-105/405	110/-75	25/-25	150	-	255
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	1965	40/-40	60	-100/380	75/-60	25/-25	115	255	685
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	1725	35/-35	50	-95/360	70/-55	25/-25	115	195	500
PRI FLIGHT COMPUTERS	VREF20	1870	45/-45	60	-100/385	90/-65	25/-25	155	255	695
SLATS DRIVE	VREF30+30	1920	40/-40	60	-100/380	80/-65	25/-25	125	240	630
STABILIZER	VREF30+20	1790	40/-40	55	-100/370	75/-60	25/-25	120	215	570

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (305 meters air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****Poor Reported Braking Action**

		LANDING DISTANCES AND ADJUSTMENTS (M)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	180000 KG LDG WT	PER 5000 KG ABV/BLW 180000 KG	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	2715	75/-70	100	-230/1120	700/-255	40/-40	150	1010	5000
ANTISKID (FLAPS 30)	VREF30	2610	75/-65	95	-230/1110	670/-250	35/-35	150	925	5000
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	2430	65/-65	80	-160/620	255/-150	35/-35	170	-	730
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	2145	55/-55	65	-145/605	225/-135	35/-35	155	-	510
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	2565	65/-60	95	-150/605	200/-120	35/-35	150	620	2050
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	2265	55/-55	75	-140/580	185/-110	35/-35	145	500	1585
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	2120	55/-55	70	-135/560	170/-105	30/-30	140	420	1240
FLAPS PRIMARY FAIL	VREF20	2280	60/-60	75	-145/580	185/-120	35/-35	160	480	1480
FLAP/SLAT CONTROL	VREF20	2090	55/-55	70	-135/555	170/-105	30/-30	135	400	1175
FLIGHT CONTROL MODE	VREF20	2355	65/-65	80	-145/595	200/-125	35/-35	175	530	1700
HYD PRESS SYS C	VREF20	2280	60/-60	75	-145/580	185/-120	35/-35	160	480	1480
HYD PRESS SYS L+C	VREF30+20	3160	75/-75	110	-200/780	395/-225	50/-50	230	-	1340
HYD PRESS SYS L+R	VREF30+20	4240	85/-80	120	-275/1075	1120/-440	75/-75	310	-	-
HYD PRESS SYS R+C	VREF30+20	3200	75/-75	115	-200/790	445/-230	50/-50	245	-	1400
HYD PRESS SYS L (FLAPS 25)	VREF25	2525	65/-60	80	-175/705	340/-175	40/-40	185	-	840
HYD PRESS SYS L (FLAPS 30)	VREF30	2415	60/-55	80	-170/700	340/-175	35/-35	185	-	730
HYD PRESS SYS R (FLAPS 25)	VREF25	2490	65/-60	80	-175/705	330/-175	40/-40	180	-	805
HYD PRESS SYS R (FLAPS 30)	VREF30	2330	55/-55	75	-165/685	315/-160	35/-35	175	-	655
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	2475	55/-55	85	-145/595	175/-115	35/-35	130	525	1605
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	2185	55/-55	75	-135/575	170/-105	30/-30	130	410	1200
PRI FLIGHT COMPUTERS	VREF20	2355	65/-65	80	-145/595	200/-125	35/-35	175	530	1700
SLATS DRIVE	VREF30+30	2410	55/-55	80	-145/585	185/-120	35/-35	140	490	1445
STABILIZER	VREF30+20	2255	55/-55	75	-140/575	175/-115	35/-35	140	450	1335

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (305 meters air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
54	129	258.6	243.7				
52	126	264.6	249.6				
50	122	270.9	255.3	236.3			
48	118	277.2	261.0	242.0			
46	115	283.6	266.6	247.5	227.9		
44	111	289.9	272.9	253.0	232.3		
42	108	294.5	279.4	258.3	236.5	219.7	
40	104	298.9	285.7	263.4	240.9	223.4	
38	100	303.1	290.9	268.8	244.9	226.8	209.6
36	97	307.2	296.1	273.9	249.0	230.3	212.9
34	93	311.2	300.9	278.2	253.1	233.7	216.1
32	90	311.3	305.3	282.4	256.9	237.2	219.3
30	86	311.3	309.7	286.6	260.6	240.8	222.4
28	82	311.4	309.7	290.4	264.4	244.5	225.8
26	79	311.4	309.7	294.1	267.9	248.0	229.2
24	75	311.5	309.8	294.9	271.1	251.4	232.5
22	72	311.6	309.8	294.9	274.2	253.5	234.1
20	68	311.6	309.9	294.9	274.8	254.5	235.5
18	64	311.6	309.9	295.0	274.9	255.6	237.2
16	61	311.6	310.0	295.1	274.9	256.1	239.0
14	57	311.7	310.0	295.1	275.0	256.1	240.5
12	54	311.7	310.1	295.2	275.0	256.2	240.6
10	50	311.8	310.2	295.2	275.1	256.2	240.7
-40	-40	312.9	311.5	296.6	276.3	257.3	241.7

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.

With engine bleed for packs off, increase weight by 900 kg.

With engine and wing anti-ice on, decrease weight by 1450 kg.

When operating in icing conditions during any part of the flight with forecast landing temperature is below 10°C, decrease weight by 20800 kg.

ADVISORY INFORMATION**Recommended Brake Cooling Schedule****Reference Brake Energy (Millions of Foot Pounds)**

		BRAKES ON SPEED (KIAS)																							
		80			100			120			140			160			180								
WEIGHT (1000 KG)	OAT (°C)	PRESSURE ALTITUDE (1000 FT)																							
		0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8						
300	0	17.3	19.1	21.2	26.1	29.1	32.6	36.4	40.8	46.0	47.9	53.9	61.0	60.4	68.1	77.1	73.2	82.4	93.0						
	10	17.9	19.7	21.8	27.0	30.0	33.7	37.6	42.1	47.5	49.5	55.7	63.0	62.4	70.4	79.6	75.6	85.0	95.8						
	15	18.2	20.0	22.2	27.4	30.5	34.2	38.2	42.9	48.3	50.3	56.7	64.1	63.5	71.5	80.8	76.8	86.3	97.2						
	20	18.4	20.3	22.5	27.9	31.0	34.8	38.9	43.6	49.1	51.2	57.6	65.1	64.5	72.7	82.1	78.0	87.6	98.5						
	30	18.8	20.8	23.1	28.6	31.8	35.7	39.9	44.7	50.5	52.6	59.2	66.9	66.3	74.7	84.3	80.2	90.0	101.1						
	40	19.1	21.0	23.4	29.0	32.4	36.3	40.6	45.6	51.5	53.7	60.5	68.4	67.8	76.4	86.3	82.0	92.0	103.3						
280	0	16.4	18.0	20.0	24.7	27.4	30.7	34.3	38.4	43.2	45.1	50.7	57.3	56.9	64.1	72.6	69.0	77.8	87.9						
	10	16.9	18.6	20.6	25.5	28.3	31.7	35.4	39.7	44.7	46.6	52.4	59.3	58.8	66.3	74.9	71.3	80.3	90.6						
	15	17.2	18.9	20.9	25.9	28.8	32.2	36.0	40.4	45.5	47.4	53.3	60.3	59.8	67.4	76.2	72.5	81.6	92.0						
	20	17.4	19.2	21.3	26.3	29.3	32.8	36.6	41.0	46.2	48.2	54.2	61.2	60.7	68.5	77.3	73.6	82.8	93.3						
	30	17.8	19.6	21.8	27.0	30.0	33.6	37.6	42.1	47.5	49.5	55.7	63.0	62.5	70.4	79.5	75.7	85.1	95.8						
	40	18.0	19.8	22.0	27.4	30.5	34.2	38.3	42.9	48.4	50.5	56.9	64.4	63.8	72.0	81.3	77.4	87.0	97.9						
260	0	15.5	17.0	18.8	23.2	25.8	28.8	32.2	36.0	40.5	42.3	47.5	53.7	53.3	60.0	67.9	64.7	73.0	82.6						
	10	15.9	17.5	19.4	24.0	26.6	29.7	33.3	37.2	41.9	43.7	49.1	55.5	55.0	62.0	70.2	66.9	75.4	85.1						
	15	16.2	17.8	19.7	24.4	27.0	30.2	33.8	37.8	42.6	44.4	49.9	56.4	56.0	63.1	71.3	68.0	76.6	86.5						
	20	16.5	18.1	20.0	24.8	27.5	30.7	34.4	38.5	43.3	45.2	50.8	57.3	56.9	64.1	72.5	69.1	77.8	87.8						
	30	16.8	18.5	20.4	25.4	28.2	31.5	35.3	39.5	44.5	46.4	52.2	58.9	58.5	65.9	74.5	71.0	79.9	90.1						
	40	17.0	18.7	20.7	25.7	28.6	32.0	35.9	40.2	45.3	47.3	53.3	60.2	59.8	67.4	76.2	72.6	81.8	92.2						
240	0	14.6	15.9	17.6	21.8	24.1	26.9	30.1	33.6	37.8	39.4	44.2	49.9	49.6	55.8	63.2	60.3	68.0	76.9						
	10	15.0	16.4	18.1	22.5	24.9	27.8	31.1	34.7	39.0	40.7	45.7	51.6	51.2	57.7	65.3	62.3	70.2	79.4						
	15	15.2	16.7	18.4	22.8	25.3	28.3	31.6	35.3	39.7	41.4	46.5	52.5	52.1	58.7	66.3	63.3	71.4	80.7						
	20	15.5	16.9	18.7	23.2	25.7	28.7	32.1	35.9	40.3	42.1	47.3	53.3	53.0	59.7	67.4	64.4	72.5	81.9						
	30	15.8	17.3	19.2	23.7	26.3	29.4	32.9	36.8	41.4	43.2	48.6	54.8	54.4	61.3	69.3	66.2	74.6	84.2						
	40	15.9	17.5	19.4	24.1	26.7	29.9	33.5	37.5	42.2	44.1	49.6	56.0	55.6	62.7	70.9	67.7	76.3	86.1						
220	0	13.6	14.9	16.4	20.3	22.4	25.0	28.0	31.2	35.0	36.5	40.9	46.1	45.8	51.6	58.3	55.7	62.8	71.1						
	10	14.1	15.4	16.9	20.9	23.2	25.8	28.9	32.2	36.1	37.7	42.3	47.7	47.3	53.3	60.2	57.6	64.9	73.4						
	15	14.3	15.6	17.2	21.3	23.5	26.2	29.4	32.7	36.7	38.4	43.0	48.5	48.2	54.2	61.2	58.5	66.0	74.6						
	20	14.5	15.9	17.5	21.6	23.9	26.7	29.8	33.3	37.3	39.0	43.7	49.3	49.0	55.1	62.2	59.5	67.0	75.8						
	30	14.8	16.2	17.9	22.1	24.5	27.3	30.6	34.1	38.3	40.0	44.9	50.6	50.3	56.6	64.0	61.2	68.9	77.9						
	40	14.9	16.3	18.1	22.4	24.8	27.7	31.1	34.7	39.0	40.8	45.8	51.7	51.3	57.9	65.4	62.5	70.5	79.7						
200	0	12.7	13.9	15.3	18.8	20.8	23.1	25.8	28.7	32.2	33.6	37.5	42.3	42.0	47.2	53.3	51.0	57.4	65.0						
	10	13.1	14.3	15.7	19.4	21.4	23.8	26.6	29.6	33.2	34.7	38.8	43.7	43.4	48.8	55.1	52.7	59.4	67.1						
	15	13.3	14.5	16.0	19.7	21.8	24.2	27.1	30.1	33.8	35.2	39.5	44.4	44.1	49.6	56.0	53.6	60.4	68.2						
	20	13.5	14.8	16.3	20.0	22.1	24.6	27.5	30.6	34.3	35.8	40.1	45.2	44.9	50.4	56.9	54.5	61.3	69.3						
	30	13.8	15.1	16.6	20.5	22.6	25.2	28.2	31.4	35.2	36.8	41.2	46.4	46.1	51.8	58.5	56.0	63.1	71.3						
	40	13.9	15.2	16.8	20.8	22.9	25.6	28.6	31.9	35.8	37.4	42.0	47.3	47.0	52.9	59.8	57.2	64.5	72.9						
180	0	11.8	12.9	14.1	17.4	19.1	21.2	23.6	26.2	29.3	30.6	34.1	38.4	38.1	42.7	48.2	46.1	51.9	58.6						
	10	12.2	13.3	14.6	17.9	19.7	21.9	24.4	27.1	30.3	31.6	35.3	39.6	39.3	44.1	49.8	47.6	53.6	60.6						
	15	12.4	13.5	14.8	18.2	20.0	22.2	24.8	27.5	30.8	32.1	35.9	40.3	40.0	44.9	50.7	48.5	54.5	61.6						
	20	12.6	13.7	15.0	18.5	20.3	22.6	25.2	28.0	31.3	32.6	36.4	41.0	40.7	45.6	51.5	49.2	55.4	62.6						
	30	12.8	14.0	15.3	18.9	20.8	23.1	25.8	28.7	32.1	33.5	37.4	42.1	41.8	46.9	52.9	50.6	57.0	64.4						
	40	12.9	14.1	15.5	19.1	21.1	23.4	26.2	29.1	32.6	34.0	38.1	42.9	42.6	47.8	54.0	51.7	58.2	65.8						

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.

If ground speed is used for brakes on speed, ignore wind and enter table with sea level, 15°C.

ADVISORY INFORMATION**Recommended Brake Cooling Schedule****Event Adjusted Brake Energy (Millions of Foot Pounds)****No Reverse Thrust**

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)								
EVENT		10	20	30	40	50	60	70	80	90
LANDING	RTO MAX MAN	10	20	30	40	50	60	70	80	90
	MAX MAN	6.3	15.6	24.9	34.0	43.2	52.3	61.6	70.9	80.4
	MAX AUTO	6.1	14.4	22.8	31.3	40.0	49.0	58.2	67.7	77.6
	AUTOBRAKE 4	5.9	13.6	21.2	29.1	37.1	45.5	54.2	63.3	73.0
	AUTOBRAKE 3	5.6	12.7	19.7	26.9	34.2	41.9	49.8	58.3	67.3
	AUTOBRAKE 2	5.3	11.8	18.2	24.8	31.5	38.4	45.6	53.3	61.5
	AUTOBRAKE 1	5.2	11.0	16.8	22.8	28.9	35.2	41.9	48.9	56.4

2 Engine Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)								
EVENT		10	20	30	40	50	60	70	80	90
LANDING	RTO MAX MAN	10	20	30	40	50	60	70	80	90
	MAX MAN	5.8	14.7	23.4	32.0	40.4	48.8	57.2	65.6	74.2
	MAX AUTO	4.3	11.6	18.9	26.4	34.1	42.0	50.2	58.9	68.0
	AUTOBRAKE 4	3.6	9.2	15.0	21.1	27.5	34.4	41.7	49.6	58.2
	AUTOBRAKE 3	2.5	6.6	11.1	15.9	21.0	26.7	32.8	39.5	46.8
	AUTOBRAKE 2	1.4	4.4	7.6	11.3	15.3	19.7	24.5	29.8	35.6
	AUTOBRAKE 1	1.0	3.0	5.3	7.8	10.6	13.9	17.5	21.7	26.4

Cooling Time (Minutes)

		EVENT ADJUSTED BRAKE ENERGY (MILLIONS OF FOOT POUNDS)									
		16 & BELOW	17	18	20	24	28	32	35	36 TO 44	45 & ABOVE
GEAR DOWN	NO SPECIAL	PROCEDURE REQUIRED	1	2	3	4	6	7	7	CAUTION	FUSE PLUG MELT ZONE
INFLIGHT											
GROUND			11	18	26	42	55	66	73		
BTMS	UP TO 2.4	2.4	2.6	2.9	3.4	4.0	4.5	4.9	5.0 TO 6.3	6.3 & ABOVE	

Observe maximum quick turnaround limit.

Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.

Add 1.0 million foot pounds for each taxi mile.

For one brake deactivated, increase brake energy by 10 percent.

For two brakes deactivated, increase brake energy by 20 percent.

When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after one hour. If overheat occurs after takeoff, extend gear soon for at least 8 minutes.

When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not attempt to taxi for one hour. Tire, wheel and brake replacement may be required. If overheat occurs after takeoff, extend gear soon for at least 12 minutes.

Brake temperature monitor system (BTMS) indication on EICAS may be used 10 to 15 minutes after airplane has come to a complete stop, or inflight with gear retracted, to determine recommended cooling schedule. (When inflight with gear extended, the BTMS indications may vary between individual brakes, due to air-stream effects.)

Performance Inflight
Engine Inoperative

Chapter PI
Section 23

ENGINE INOP

Initial Max Continuous EPR
Based on .84M, engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20 & ABOVE	1.243	1.234	1.226	1.211	1.192	1.183	1.181	1.175	1.170
15	1.284	1.275	1.263	1.250	1.232	1.222	1.220	1.216	1.212
10	1.327	1.319	1.307	1.288	1.273	1.264	1.262	1.259	1.257
5	1.364	1.366	1.354	1.337	1.314	1.306	1.304	1.302	1.300
0	1.364	1.402	1.406	1.388	1.368	1.355	1.354	1.351	1.349
-5	1.364	1.402	1.439	1.444	1.424	1.412	1.411	1.408	1.406
-10	1.364	1.402	1.439	1.473	1.482	1.471	1.469	1.467	1.465
-15	1.364	1.402	1.439	1.473	1.506	1.523	1.523	1.521	1.518
-20 & BELOW	1.364	1.402	1.439	1.473	1.506	1.523	1.523	1.521	1.518

ENGINE INOP

Max Continuous EPR

Based on engine bleed for packs on or off and anti-ice off

37000 FT to 29000 FT Pressure Altitudes

37000 FT PRESS ALT			TAT (°C)										
CIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
200	0.63	1.531	1.531	1.531	1.531	1.531	1.489	1.436	1.385	1.341	1.302	1.263	1.233
240	0.74	1.534	1.534	1.534	1.534	1.534	1.517	1.455	1.402	1.349	1.308	1.268	
280	0.86	1.506	1.506	1.506	1.506	1.506	1.506	1.506	1.506	1.469	1.413	1.356	1.304
35000 FT PRESS ALT			TAT (°C)										
CIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
200	0.60	1.517	1.517	1.517	1.517	1.517	1.486	1.433	1.385	1.341	1.304	1.267	1.234
240	0.71	1.514	1.514	1.514	1.514	1.514	1.514	1.502	1.444	1.394	1.344	1.305	1.266
280	0.82	1.519	1.519	1.519	1.519	1.519	1.519	1.519	1.519	1.476	1.417	1.362	1.311
33000 FT PRESS ALT			TAT (°C)										
CIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
200	0.58	1.499	1.499	1.499	1.499	1.499	1.499	1.447	1.401	1.358	1.323	1.290	1.257
240	0.68	1.491	1.491	1.491	1.491	1.491	1.491	1.491	1.452	1.402	1.355	1.314	1.278
280	0.79	1.489	1.489	1.489	1.489	1.489	1.489	1.489	1.489	1.472	1.414	1.363	1.314
320	0.89	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.389	1.338
31000 FT PRESS ALT			TAT (°C)										
CIAS	M	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10
200	0.55	1.480	1.480	1.480	1.480	1.480	1.461	1.414	1.372	1.332	1.303	1.274	1.245
240	0.66	1.471	1.471	1.471	1.471	1.471	1.471	1.461	1.410	1.365	1.322	1.291	1.260
280	0.76	1.459	1.459	1.459	1.459	1.459	1.459	1.459	1.459	1.415	1.366	1.321	1.281
320	0.85	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.406	1.353	1.306
29000 FT PRESS ALT			TAT (°C)										
CIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
200	0.53	1.493	1.493	1.493	1.493	1.493	1.454	1.411	1.369	1.334	1.302	1.270	1.252
240	0.63	1.475	1.475	1.475	1.475	1.475	1.475	1.441	1.395	1.352	1.315	1.286	1.255
280	0.73	1.446	1.446	1.446	1.446	1.446	1.446	1.446	1.426	1.378	1.334	1.293	1.259
320	0.82	1.413	1.413	1.413	1.413	1.413	1.413	1.413	1.413	1.413	1.362	1.317	1.273
360	0.91	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.330	1.284

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	37	35	33	31	29
ENGINE ONLY	-0.004	-0.003	-0.003	-0.003	-0.003
ENGINE & WING*	-0.015	-0.014	-0.013	-0.012	-0.012
ENGINE & WING**	-0.026	-0.024	-0.022	-0.021	-0.020

* Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

ENGINE INOP**Max Continuous EPR****Based on engine bleed for packs on or off and anti-ice off****27000 FT to 20000 Pressure Altitudes**

27000 FT PRESS ALT		TAT (°C)											
KLAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
200	0.51	1.507	1.507	1.507	1.507	1.507	1.499	1.452	1.409	1.368	1.336	1.302	1.268
240	0.60	1.488	1.488	1.488	1.488	1.488	1.488	1.483	1.434	1.391	1.349	1.317	1.286
280	0.70	1.443	1.443	1.443	1.443	1.443	1.443	1.443	1.443	1.398	1.355	1.314	1.279
320	0.79	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.368	1.323	1.282
360	0.88	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.325	1.281
25000 FT PRESS ALT		TAT (°C)											
KLAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	0.49	1.521	1.521	1.521	1.521	1.521	1.496	1.450	1.407	1.369	1.337	1.303	1.278
240	0.58	1.502	1.502	1.502	1.502	1.502	1.502	1.477	1.431	1.389	1.350	1.316	1.282
280	0.67	1.450	1.450	1.450	1.450	1.450	1.450	1.450	1.430	1.384	1.344	1.305	1.273
320	0.76	1.386	1.386	1.386	1.386	1.386	1.386	1.386	1.386	1.380	1.335	1.296	1.257
360	0.85	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.288	1.249
24000 FT PRESS ALT		TAT (°C)											
KLAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	0.48	1.523	1.523	1.523	1.523	1.523	1.512	1.465	1.420	1.379	1.346	1.312	1.278
240	0.57	1.502	1.502	1.502	1.502	1.502	1.502	1.490	1.443	1.399	1.357	1.324	1.289
280	0.66	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.447	1.400	1.358	1.316	1.283
320	0.75	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.350	1.309	1.269
360	0.83	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.300	1.259
22000 FT PRESS ALT		TAT (°C)											
KLAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
200	0.46	1.523	1.523	1.523	1.523	1.523	1.496	1.449	1.404	1.364	1.330	1.295	1.271
240	0.55	1.505	1.505	1.505	1.505	1.505	1.505	1.473	1.426	1.380	1.341	1.307	1.273
280	0.63	1.463	1.463	1.463	1.463	1.463	1.463	1.463	1.433	1.387	1.342	1.302	1.269
320	0.72	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.385	1.340	1.297	1.255
360	0.80	1.336	1.336	1.336	1.336	1.336	1.336	1.336	1.336	1.336	1.329	1.287	1.246
20000 FT PRESS ALT		TAT (°C)											
KLAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
200	0.44	1.519	1.519	1.519	1.519	1.519	1.519	1.477	1.429	1.383	1.346	1.311	1.275
240	0.53	1.512	1.512	1.512	1.512	1.512	1.512	1.509	1.461	1.413	1.366	1.329	1.294
280	0.61	1.469	1.469	1.469	1.469	1.469	1.469	1.469	1.465	1.417	1.368	1.321	1.287
320	0.69	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.376	1.329	1.283
360	0.77	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.317	1.274

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	27	25	24	22	20
ENGINE ONLY	-0.004	-0.005	-0.006	-0.007	-0.006
ENGINE & WING*	-0.012	-0.012	-0.012	-0.013	-0.012
ENGINE & WING**	-0.019	-0.019	-0.019	-0.019	-0.018

* Wing anti-ice on, packs on.

** Wing anti-ice on, packs off.

ENGINE INOP

Max Continuous EPR
Based on engine bleed for packs on or off and anti-ice off
18000 FT to 5000 FT Pressure Altitudes

18000 FT PRESS ALT			TAT (°C)										
CIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	0.42	1.511	1.511	1.511	1.511	1.511	1.500	1.455	1.411	1.369	1.337	1.305	1.275
240	0.51	1.515	1.515	1.515	1.515	1.515	1.515	1.495	1.449	1.403	1.362	1.328	1.293
280	0.59	1.472	1.472	1.472	1.472	1.472	1.472	1.472	1.447	1.400	1.354	1.313	1.282
320	0.67	1.424	1.424	1.424	1.424	1.424	1.424	1.424	1.424	1.402	1.356	1.311	1.269
360	0.75	1.362	1.362	1.362	1.362	1.362	1.362	1.362	1.362	1.362	1.349	1.305	1.262
16000 FT PRESS ALT			TAT (°C)										
CIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	0.41	1.504	1.504	1.504	1.504	1.504	1.504	1.479	1.438	1.396	1.360	1.332	1.304
240	0.49	1.511	1.511	1.511	1.511	1.511	1.511	1.511	1.477	1.432	1.389	1.354	1.322
280	0.57	1.474	1.474	1.474	1.474	1.474	1.474	1.474	1.474	1.432	1.387	1.344	1.310
320	0.64	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.384	1.340	1.296
360	0.72	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.337	1.294
14000 FT PRESS ALT			TAT (°C)										
CIAS	M	-20	-15	-10	-5	0	5	10	15	20	25	30	35
200	0.39	1.488	1.488	1.488	1.488	1.488	1.488	1.452	1.413	1.373	1.343	1.315	1.288
240	0.47	1.491	1.491	1.491	1.491	1.491	1.491	1.484	1.444	1.402	1.361	1.330	1.298
280	0.54	1.463	1.463	1.463	1.463	1.463	1.463	1.463	1.449	1.407	1.365	1.324	1.293
320	0.62	1.417	1.417	1.417	1.417	1.417	1.417	1.417	1.417	1.400	1.357	1.315	1.275
360	0.69	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.354	1.313	1.272
12000 FT PRESS ALT			TAT (°C)										
CIAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40
200	0.38	1.475	1.475	1.475	1.475	1.475	1.468	1.431	1.393	1.355	1.329	1.302	1.276
240	0.45	1.473	1.473	1.473	1.473	1.473	1.473	1.453	1.415	1.375	1.339	1.308	1.277
280	0.52	1.452	1.452	1.452	1.452	1.452	1.452	1.452	1.424	1.385	1.344	1.308	1.275
320	0.60	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.373	1.333	1.292	1.257
360	0.67	1.359	1.359	1.359	1.359	1.359	1.359	1.359	1.359	1.359	1.327	1.288	1.248
10000 FT PRESS ALT			TAT (°C)										
CIAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40
200	0.36	1.462	1.462	1.462	1.462	1.462	1.462	1.444	1.408	1.371	1.338	1.311	1.284
240	0.43	1.452	1.452	1.452	1.452	1.452	1.452	1.452	1.421	1.383	1.345	1.313	1.283
280	0.51	1.438	1.438	1.438	1.438	1.438	1.438	1.438	1.433	1.397	1.358	1.318	1.286
320	0.58	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.382	1.344	1.305	1.265
360	0.65	1.344	1.344	1.344	1.344	1.344	1.344	1.344	1.344	1.344	1.332	1.295	1.258
5000 FT PRESS ALT			TAT (°C)										
CIAS	M	-10	-5	0	5	10	15	20	25	30	35	40	45
200	0.33	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.399	1.367	1.334	1.306	1.282
240	0.40	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.394	1.361	1.328	1.295	1.269
280	0.46	1.382	1.382	1.382	1.382	1.382	1.382	1.382	1.382	1.365	1.330	1.295	1.263
320	0.53	1.349	1.349	1.349	1.349	1.349	1.349	1.349	1.349	1.349	1.323	1.288	1.253
360	0.59	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.270	1.237

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	18	16	14	12	10	5
ENGINE ONLY	-0.010	-0.013	-0.015	-0.015	-0.015	-0.010
ENGINE & WING*	-0.015	-0.018	-0.019	-0.019	-0.018	-0.012
ENGINE & WING**	-0.021	-0.024	-0.024	-0.023	-0.022	-0.014

* Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

Includes APU fuel burn

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
300	290	282	17500	16100	14600
280	271	273	19400	18000	16600
260	252	264	21300	20000	18600
240	232	253	23300	22100	20700
220	213	243	25400	24200	22900
200	194	231	27400	26200	25100
180	174	219	29500	28300	27200
160	154	206	32200	30600	29500

ENGINE INOP

MAX CONTINUOUS THRUST

**Driftdown/LRC Cruise Range Capability
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
136	127	119	112	106	100	95	90	86	82	79
272	254	238	224	211	200	190	181	173	165	158
407	380	356	335	317	300	285	271	259	248	238
541	505	474	447	422	400	380	362	346	331	317
675	631	592	558	527	500	475	453	433	414	397
808	755	709	669	633	600	571	544	520	498	477
940	880	827	780	738	700	666	635	607	581	558
1072	1004	944	890	843	800	761	726	694	665	638
1204	1128	1061	1001	948	900	857	817	782	749	719
1335	1251	1177	1112	1053	1000	952	909	869	833	799
1467	1375	1294	1222	1158	1100	1048	1000	957	917	880
1598	1499	1411	1333	1263	1200	1143	1091	1044	1001	961
1729	1622	1527	1443	1368	1300	1239	1183	1132	1085	1042
1860	1746	1644	1554	1473	1400	1334	1274	1219	1169	1122
1992	1869	1761	1664	1578	1500	1429	1365	1306	1253	1203
2123	1993	1878	1775	1683	1600	1525	1456	1394	1336	1284
2255	2117	1995	1886	1788	1700	1620	1548	1481	1420	1364
2388	2241	2112	1997	1893	1800	1716	1639	1568	1504	1445

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG)								TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 KG)								
	160	180	200	220	240	260	280	300	
100	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	0:16
200	2.5	2.6	2.8	2.9	3.1	3.2	3.3	3.4	0:32
300	3.8	4.1	4.4	4.7	5.0	5.2	5.5	5.7	0:47
400	5.1	5.6	6.0	6.5	6.9	7.4	7.8	8.2	1:03
500	6.4	7.0	7.6	8.2	8.9	9.4	10.0	10.6	1:18
600	7.7	8.4	9.1	9.9	10.7	11.4	12.1	12.9	1:33
700	8.9	9.8	10.6	11.5	12.5	13.3	14.2	15.1	1:47
800	10.1	11.1	12.1	13.1	14.2	15.2	16.3	17.3	2:02
900	11.3	12.5	13.6	14.7	16.0	17.2	18.3	19.5	2:16
1000	12.5	13.8	15.1	16.4	17.7	19.1	20.4	21.6	2:31
1100	13.6	15.1	16.5	18.0	19.5	20.9	22.4	23.8	2:45
1200	14.8	16.4	18.0	19.5	21.2	22.8	24.4	25.9	2:59
1300	16.0	17.7	19.4	21.1	22.9	24.7	26.4	28.1	3:14
1400	17.1	19.0	20.8	22.7	24.6	26.5	28.4	30.2	3:28
1500	18.3	20.3	22.3	24.2	26.3	28.3	30.3	32.3	3:42
1600	19.4	21.6	23.7	25.8	28.0	30.1	32.3	34.4	3:57
1700	20.6	22.8	25.1	27.3	29.7	32.0	34.2	36.5	4:11
1800	21.7	24.1	26.5	28.8	31.3	33.7	36.2	38.5	4:26

Includes APU fuel burn.

Driftdown at optimum driftdown speed and cruise at LRC speed.

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
300	15000	12700	10300
290	15700	13600	11200
280	16300	14400	12000
270	17000	15300	13000
260	18100	16500	14600
250	19200	17600	15800
240	20300	18800	17000
230	21400	20000	18200
220	22500	21100	19400
210	23600	22300	20700
200	24800	23500	22000
190	26000	24800	23400
180	27300	26000	24800
170	28600	27300	26100
160	30000	28600	27400

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)							
		10	15	17	19	21	23	25	27
300	EPR	1.259	1.366						
	MACH	.585	.641						
	KIAS	325	325						
	FF/ENG	8919	9092						
280	EPR	1.236	1.333	1.383					
	MACH	.585	.641	.665					
	KIAS	325	325	325					
	FF/ENG	8548	8681	8780					
260	EPR	1.213	1.297	1.341	1.398				
	MACH	.577	.627	.651	.680				
	KIAS	321	318	318	320				
	FF/ENG	8069	8080	8152	8331				
240	EPR	1.188	1.260	1.298	1.344	1.402			
	MACH	.558	.606	.627	.652	.681			
	KIAS	310	307	306	306	308			
	FF/ENG	7412	7389	7412	7482	7658			
220	EPR	1.164	1.226	1.258	1.297	1.343	1.402		
	MACH	.538	.585	.605	.626	.651	.681		
	KIAS	298	296	294	294	294	296		
	FF/ENG	6764	6736	6728	6748	6810	6972		
200	EPR	1.141	1.195	1.223	1.254	1.293	1.339	1.398	
	MACH	.516	.562	.581	.601	.623	.648	.677	
	KIAS	286	284	283	282	281	281	282	
	FF/ENG	6126	6094	6085	6077	6089	6140	6273	
180	EPR	1.119	1.166	1.189	1.217	1.247	1.284	1.330	1.386
	MACH	.492	.537	.556	.576	.596	.617	.642	.671
	KIAS	272	271	270	269	268	267	267	268
	FF/ENG	5490	5462	5451	5443	5434	5438	5475	5573
160	EPR	1.098	1.139	1.158	1.181	1.207	1.237	1.272	1.316
	MACH	.466	.510	.529	.548	.568	.588	.609	.633
	KIAS	258	257	256	256	255	254	253	252
	FF/ENG	4862	4838	4827	4817	4809	4800	4796	4817

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
287	264	244	227	213	200	191	182	174	167	160
576	530	489	455	426	400	381	364	348	334	321
865	796	735	684	640	600	572	546	522	501	482
1156	1064	982	913	853	800	763	729	698	669	643
1448	1332	1229	1142	1067	1000	953	910	871	835	803
1742	1602	1477	1372	1281	1200	1144	1092	1045	1002	963
2036	1871	1725	1602	1495	1400	1335	1274	1219	1168	1122
2332	2141	1973	1831	1709	1600	1525	1456	1392	1334	1282
2629	2414	2223	2062	1924	1800	1715	1637	1565	1500	1441

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	3.4	0:40	3.0	0:38	2.6	0:37	2.4	0:36	2.1	0:34
400	7.1	1:17	6.5	1:13	6.0	1:10	5.5	1:07	5.2	1:03
600	10.9	1:54	10.0	1:48	9.3	1:43	8.7	1:38	8.2	1:33
800	14.5	2:31	13.5	2:24	12.6	2:17	11.8	2:10	11.2	2:02
1000	18.2	3:09	16.9	2:59	15.8	2:51	14.9	2:42	14.2	2:32
1200	21.8	3:47	20.3	3:35	19.1	3:25	17.9	3:14	17.1	3:02
1400	25.3	4:26	23.7	4:12	22.2	3:59	20.9	3:47	20.0	3:33
1600	28.8	5:05	27.0	4:48	25.4	4:33	23.9	4:19	22.9	4:03
1800	32.3	5:44	30.3	5:25	28.5	5:08	26.9	4:52	25.7	4:34

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)							
	160	180	200	220	240	260	280	300
2	-0.1	-0.1	0.0	0.1	0.3	0.4	0.6	0.7
4	-0.4	-0.2	0.0	0.4	0.7	1.1	1.5	1.9
6	-0.6	-0.3	0.0	0.6	1.2	1.8	2.4	3.1
8	-0.9	-0.4	0.0	0.8	1.6	2.5	3.4	4.3
10	-1.1	-0.5	0.0	1.0	2.1	3.2	4.3	5.4
12	-1.3	-0.7	0.0	1.2	2.5	3.8	5.2	6.6
14	-1.6	-0.8	0.0	1.4	2.9	4.5	6.1	7.7
16	-1.8	-0.9	0.0	1.6	3.3	5.1	6.9	8.8
18	-2.0	-1.0	0.0	1.8	3.7	5.7	7.8	10.0
20	-2.3	-1.1	0.0	2.0	4.1	6.3	8.6	11.1
22	-2.5	-1.2	0.0	2.2	4.5	6.9	9.5	12.1
24	-2.8	-1.4	0.0	2.4	4.9	7.5	10.3	13.2
26	-3.0	-1.5	0.0	2.5	5.2	8.1	11.1	14.3
28	-3.2	-1.6	0.0	2.7	5.6	8.7	11.9	15.4
30	-3.5	-1.7	0.0	2.9	5.9	9.2	12.7	16.4
32	-3.7	-1.8	0.0	3.0	6.2	9.7	13.5	17.4
34	-3.9	-2.0	0.0	3.1	6.6	10.3	14.2	18.5

ENGINE INOP
MAX CONTINUOUS THRUST

**Holding
Flaps up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
300	EPR	1.163	1.200	1.271	1.363		
	KIAS	260	260	262	277		
	FF/ENG	8080	8090	8160	8510		
280	EPR	1.147	1.179	1.242	1.327	1.460	
	KIAS	251	251	253	261	286	
	FF/ENG	7480	7480	7530	7730	8420	
260	EPR	1.131	1.159	1.215	1.294	1.401	
	KIAS	242	242	243	246	266	
	FF/ENG	6890	6900	6910	7010	7430	
240	EPR	1.116	1.141	1.189	1.259	1.352	
	KIAS	232	233	234	235	247	
	FF/ENG	6310	6310	6320	6370	6620	
220	EPR	1.102	1.124	1.165	1.225	1.310	1.437
	KIAS	222	223	224	224	230	251
	FF/ENG	5750	5740	5740	5760	5880	6350
200	EPR	1.088	1.106	1.142	1.193	1.269	1.370
	KIAS	215	215	215	215	215	229
	FF/ENG	5230	5190	5190	5180	5230	5480
180	EPR	1.075	1.090	1.119	1.161	1.225	1.316
	KIAS	208	208	208	208	208	209
	FF/ENG	4840	4680	4650	4650	4670	4750
160	EPR	1.061	1.074	1.097	1.133	1.183	1.259
	KIAS	203	203	203	203	203	203
	FF/ENG	4360	4310	4160	4160	4160	4180
140	EPR	1.047	1.058	1.076	1.105	1.146	1.208
	KIAS	203	203	203	203	203	203
	FF/ENG	3960	3910	3760	3740	3780	3750

This table includes 5% additional fuel for holding in a racetrack pattern.

ENGINE INOP

ADVISORY INFORMATION

**Gear Down Landing Rate of Climb Available
Flaps 20**

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	550	460				
50	600	510	380			
48	650	550	420			
46	690	600	470	310		
44	720	650	510	340		
42	760	690	550	370	230	
40	790	730	580	400	260	
38	820	760	610	440	290	150
36	840	800	650	470	320	180
34	840	830	680	500	350	200
32	850	850	710	530	380	230
30	850	850	730	550	410	260
20	870	870	760	620	480	340
10	890	890	770	630	490	360
0	900	900	790	650	500	370
-20	940	940	820	670	520	390
-40	990	990	860	710	550	400

Rate of climb capability shown is valid for 200000 kg, gear down at VREF20 + 5.

Decrease rate of climb 40 ft/min per 5000 kg greater than 200000 kg.

Increase rate of climb 60 ft/min per 5000 kg less than 200000 kg.

Flaps 30

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	50	-50				
50	90	-10	-140			
48	130	30	-100			
46	170	80	-60	-220		
44	200	120	-20	-190		
42	230	160	20	-160	-290	
40	260	190	50	-130	-270	
38	290	230	80	-100	-240	-380
36	310	260	110	-70	-220	-360
34	310	290	130	-40	-190	-340
32	320	310	160	-20	-170	-310
30	320	310	180	10	-140	-290
20	320	320	200	60	-80	-220
10	330	330	210	70	-80	-210
0	340	330	210	70	-80	-210
-20	360	350	220	70	-80	-210
-40	380	370	240	80	-80	-220

Rate of climb capability shown is valid for 200000 kg, gear down at VREF30 + 5.

Decrease rate of climb 40 ft/min per 5000 kg greater than 200000 kg.

Increase rate of climb 60 ft/min per 5000 kg less than 200000 kg.

Intentionally
Blank

Performance Inflight

Alternate Mode EEC

Chapter PI

Section 24

ALTERNATE MODE EEC

Limit Weight

PERFORMANCE LIMIT	ALTERNATE MODE EEC LIMIT WEIGHT (1000 KG)									
	PRIMARY MODE PERFORMANCE LIMIT WEIGHT (1000 KG)									
	140	160	180	200	220	240	260	280	300	320
FIELD	134.5	153.0	171.5	190.0	208.5	227.0	245.5	264.0	282.5	301.0
CLIMB	127.9	146.2	164.5	182.8	201.1	219.4	237.6	255.9	274.2	292.5
OBSTACLE	130.0	148.1	166.2	184.3	202.4	220.5	238.6	256.7	274.8	292.9
NET LEVEL OFF WEIGHT	130.0	148.4	166.9	185.3	203.8	222.2	240.7	259.1	277.5	296.0
LANDING CLIMB	127.2	145.6	164.1	182.5	200.9	219.4	237.8	256.2	274.6	293.1

Takeoff Speed Adjustment

TAKEOFF SPEEDS	TAKEOFF SPEED ADJUSTMENT (KTS)
V1	+1
VR	0
V2	0

Max Takeoff %N1

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)										
°C	°F	-2000	0	1000	2000	3000	4000	5000	6000	7000	8000	8400
55	131	92.4	92.7	92.9	93.1	93.3	93.4	93.4	93.4	93.3	93.2	93.1
50	122	93.4	93.9	93.9	93.9	93.9	94.0	94.1	94.1	94.0	94.0	93.9
45	113	94.4	95.0	95.0	95.0	94.8	94.7	94.7	94.7	94.7	94.6	94.6
40	104	94.9	96.3	96.1	96.1	95.7	95.4	95.3	95.3	95.3	95.3	95.2
35	95	95.4	96.9	97.0	96.9	96.5	96.1	96.1	96.0	96.0	96.0	96.0
30	86	94.9	98.0	97.8	97.8	97.4	97.0	96.9	96.9	96.8	96.8	96.7
25	77	94.1	97.4	97.8	98.2	97.9	97.6	97.8	97.7	97.6	97.6	97.6
20	68	93.3	96.6	97.0	97.4	97.6	97.8	97.7	97.8	97.9	97.8	97.8
15	59	92.5	95.7	96.1	96.6	96.8	96.9	97.2	97.4	97.8	98.0	97.9
10	50	91.7	94.9	95.3	95.7	95.9	96.1	96.3	96.5	96.9	97.3	97.5
5	41	90.9	94.0	94.4	94.9	95.1	95.2	95.5	95.7	96.1	96.5	96.6
0	32	90.1	93.2	93.6	94.0	94.2	94.4	94.6	94.8	95.2	95.6	95.8
-10	14	88.4	91.5	91.9	92.3	92.5	92.6	92.9	93.1	93.5	93.8	94.0
-20	-4	86.7	89.7	90.1	90.5	90.7	90.9	91.1	91.3	91.7	92.0	92.2
-30	-22	85.0	87.9	88.3	88.7	88.9	89.0	89.3	89.5	89.8	90.2	90.3
-40	-40	83.2	86.1	86.5	86.9	87.0	87.2	87.4	87.6	88.0	88.3	88.5
-50	-58	81.4	84.2	84.6	85.0	85.1	85.3	85.5	85.7	86.1	86.4	86.5

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
PACKS OFF	0.1	0.2	0.2	0.2	0.2	0.2
WING ANTI-ICE ON	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3

ALTERNATE MODE EEC**Max Climb %N1****Based on engine bleed for packs on or off and anti-ice off**

TAT (°C)	PRESSURE ALTITUDE (FT) / SPEED (KIAS OR MACH)									
	0	5000	10000	15000	20000	25000	30000	35000	40000	43000
	310	310	310	310	310	310	310	.84	.84	.84
60	83.9	84.6	86.7	89.4	92.2	93.4	94.5	96.1	96.3	96.0
50	85.4	86.2	86.7	88.1	90.8	92.0	93.1	94.7	94.9	94.5
40	86.8	87.5	88.0	88.9	89.8	90.6	91.6	93.2	93.4	93.1
30	85.9	88.8	89.4	90.2	91.0	90.8	90.5	91.7	91.9	91.6
20	84.5	87.3	89.8	91.3	92.1	91.8	91.9	90.9	90.3	90.0
15	83.7	86.6	89.1	91.7	92.6	92.5	92.3	91.5	91.1	90.9
10	83.0	85.8	88.3	90.9	93.2	93.1	92.9	92.1	91.7	91.5
5	82.3	85.1	87.5	90.1	92.8	93.9	93.6	92.5	92.2	92.1
0	81.5	84.3	86.7	89.3	92.0	93.9	94.5	93.3	92.8	92.7
-5	80.8	83.5	85.9	88.5	91.1	93.0	94.6	94.3	93.8	93.7
-10	80.0	82.7	85.1	87.7	90.3	92.1	93.7	95.4	94.9	94.8
-15	79.3	81.9	84.3	86.8	89.4	91.2	92.9	95.4	96.0	95.9
-20	78.5	81.1	83.5	86.0	88.5	90.4	91.9	94.5	95.0	94.9
-25	77.7	80.3	82.7	85.1	87.7	89.5	91.0	93.5	94.1	94.0
-30	76.9	79.5	81.8	84.3	86.8	88.5	90.1	92.6	93.1	93.0
-35	76.1	78.7	81.0	83.4	85.9	87.6	89.2	91.6	92.2	92.1
-40	75.3	77.9	80.1	82.5	85.0	86.7	88.2	90.7	91.2	91.1

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)									
	0	5000	10000	15000	20000	25000	30000	35000	40000	43000
ENGINE ANTI-ICE ON	-0.4	-0.5	-0.7	-0.6	-0.3	-0.2	-0.1	-0.1	-0.1	-0.2
ENGINE & WING ANTI-ICE ON	-0.5	-0.6	-0.8	-0.8	-0.5	-0.5	-0.4	-0.5	-0.6	-0.7

Max Cruise %N1**Based on engine bleed for packs on or off and anti-ice off**

TAT (°C)	PRESSURE ALTITUDE (FT)									
	25000	27000	29000	31000	33000	35000	37000	39000	41000	43000
25	89.6	89.4	89.5	89.9	89.2	89.3	89.6	89.5	89.3	89.1
20	90.1	90.0	90.1	90.4	89.9	89.2	88.9	88.8	88.6	88.4
15	90.7	90.5	90.6	90.9	90.5	89.9	89.5	89.5	89.3	89.2
10	91.1	91.0	91.1	91.4	90.9	90.4	90.1	90.1	90.0	89.9
5	91.7	91.5	91.6	91.9	91.4	90.8	90.6	90.5	90.5	90.4
0	91.5	91.9	92.2	92.5	92.0	91.4	91.1	91.0	91.0	90.9
-5	90.7	91.1	91.8	92.6	92.7	92.1	91.8	91.7	91.7	91.6
-10	89.8	90.2	91.0	91.7	92.6	92.9	92.6	92.5	92.5	92.4
-15	89.0	89.4	90.1	90.8	91.7	92.7	93.2	93.1	93.1	93.0
-20	88.1	88.5	89.2	89.9	90.8	91.8	92.2	92.2	92.2	92.1
-25	87.2	87.6	88.3	89.0	89.9	90.9	91.3	91.3	91.3	91.2
-30	86.3	86.7	87.5	88.1	89.0	89.9	90.4	90.4	90.3	90.3
-35	85.4	85.8	86.5	87.2	88.1	89.0	89.5	89.4	89.4	89.3

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)				
	25000	30000	35000	40000	43000
ENGINE ANTI-ICE ON	-0.1	-0.1	-0.1	-0.1	-0.1
ENGINE & WING ANTI-ICE ON	-0.4	-0.4	-0.5	-0.5	-0.6

ALTERNATE MODE EEC**Go-Around %N1****Based on engine bleed for packs on, engine anti-ice on or off, wing anti-ice off**

AIRPORT OAT		TAT (°C)	PRESSURE ALTITUDE (FT)											
°C	°F		-2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
51	124	55	93.4	93.9	93.9	93.8	94.0	94.2	94.3	94.3	94.3	94.2	94.1	94.1
46	115	50	94.4	95.0	95.1	95.1	94.9	94.8	94.9	95.0	94.9	94.9	94.9	94.8
41	106	45	95.1	96.2	96.1	96.1	95.8	95.6	95.6	95.6	95.5	95.5	95.5	95.5
36	97	40	95.5	97.0	97.0	96.9	96.6	96.2	96.2	96.2	96.1	96.1	96.0	96.0
31	88	35	95.3	97.7	97.7	97.7	97.3	97.0	96.9	96.9	96.8	96.8	96.8	96.7
26	79	30	94.6	97.3	98.0	98.4	98.0	97.7	97.7	97.6	97.6	97.6	97.5	97.5
21	70	25	93.8	96.5	97.2	97.8	98.1	98.3	98.1	98.2	98.2	98.1	98.0	98.0
17	62	20	93.0	95.7	96.4	97.0	97.2	97.5	97.8	98.0	98.3	98.3	98.1	97.9
12	53	15	92.2	94.9	95.5	96.1	96.4	96.7	96.9	97.1	97.6	98.0	98.3	98.3
7	45	10	91.4	94.0	94.7	95.3	95.6	95.9	96.1	96.3	96.7	97.1	97.5	97.9
2	36	5	90.6	93.2	93.9	94.4	94.7	95.0	95.2	95.4	95.9	96.3	96.6	97.0
-3	27	0	89.8	92.4	93.0	93.6	93.9	94.1	94.4	94.6	95.0	95.4	95.8	96.1
-13	9	-10	88.1	90.7	91.3	91.9	92.1	92.4	92.6	92.8	93.3	93.6	94.0	94.3
-23	-9	-20	86.4	88.9	89.5	90.1	90.4	90.6	90.8	91.0	91.5	91.8	92.2	92.5
-33	-27	-30	84.7	87.1	87.8	88.3	88.6	88.8	89.0	89.2	89.6	90.0	90.3	90.7
-43	-45	-40	82.9	85.3	85.9	86.5	86.7	87.0	87.2	87.4	87.8	88.1	88.5	88.8
-53	-63	-50	81.1	83.5	84.1	84.6	84.8	85.1	85.3	85.5	85.9	86.2	86.5	86.9

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)						
	-2000	0	2000	4000	6000	8000	10000
PACKS OFF	0.1	0.1	0.2	0.2	0.2	0.2	0.2
1 PACK ON	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
WING ANTI-ICE ON	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3

Intentionally
Blank

Performance Inflight

Alternate Mode EEC, Engine INOP

Chapter PI

Section 25

ALTERNATE MODE EEC

ENGINE INOP

Initial Max Continuous %N1

Based on .84M, engine bleed for packs on or off and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	92.7	92.4	92.1	91.6	90.9	90.5	90.5	90.2	90.0
15	93.2	92.9	92.5	92.1	91.5	91.2	91.1	91.0	90.9
10	93.7	93.5	93.1	92.5	92.1	91.8	91.7	91.6	91.5
5	94.1	94.1	93.7	93.2	92.5	92.3	92.2	92.1	92.1
0	93.2	94.4	94.6	94.0	93.3	92.9	92.9	92.8	92.8
-5	92.4	93.6	94.8	94.9	94.3	93.9	93.9	93.8	93.7
-10	91.5	92.7	93.9	95.1	95.4	95.0	95.0	94.9	94.8
-15	90.6	91.8	93.0	94.2	95.4	96.0	96.0	95.9	95.9
-20	89.7	90.9	92.1	93.3	94.5	95.1	95.1	95.0	94.9
-25	88.9	90.0	91.2	92.3	93.6	94.1	94.1	94.1	94.0
-30	88.0	89.1	90.3	91.4	92.6	93.2	93.2	93.1	93.0
-35	87.0	88.2	89.3	90.5	91.6	92.2	92.2	92.1	92.1
-40	86.1	87.2	88.4	89.5	90.7	91.3	91.2	91.2	91.1

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
ENGINE ONLY	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2
ENGINE & WING*	-0.4	-0.4	-0.4	-0.4	-0.5	-0.5	-0.6	-0.6	-0.7
ENGINE & WING**	-0.6	-0.6	-0.7	-0.8	-0.9	-0.9	-1.0	-1.1	-1.2

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

ALTERNATE MODE EEC

ENGINE INOP

Max Continuous %N1

Based on engine bleed for packs on or off and anti-ice off

320 KIAS

TAT (°C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	93.6	94.2	94.1	93.7	93.4	92.7	92.1	91.6	91.2	91.1	90.9	91.0	91.0	90.5	90.8	91.9
25	92.9	95.0	95.0	94.6	94.3	93.5	92.9	92.2	91.7	91.6	91.6	91.7	91.7	91.3	91.5	92.3
20	92.1	94.6	95.6	95.6	95.3	94.5	93.8	93.0	92.3	92.1	92.0	92.2	92.2	91.8	92.0	92.7
15	91.3	93.8	94.8	95.5	96.3	95.6	94.9	93.8	93.0	92.7	92.6	92.7	92.7	92.3	92.5	93.2
10	90.5	93.0	94.0	94.7	95.5	95.7	96.0	94.8	93.7	93.3	93.2	93.3	93.2	92.9	93.0	93.8
5	89.7	92.2	93.1	93.9	94.6	94.9	95.1	94.8	94.5	94.1	94.0	94.0	93.8	93.5	93.7	94.6
0	88.9	91.3	92.3	93.0	93.8	94.0	94.3	93.9	93.6	93.5	94.1	94.8	94.6	94.3	94.5	95.4
-5	88.1	90.5	91.4	92.2	92.9	93.1	93.4	93.1	92.8	92.7	93.2	93.9	94.4	94.7	95.5	95.9
-10	87.2	89.6	90.6	91.3	92.0	92.3	92.5	92.2	91.9	91.8	92.3	93.0	93.5	93.8	94.6	95.0
-15	86.4	88.8	89.7	90.4	91.2	91.4	91.7	91.3	91.0	90.9	91.4	92.2	92.6	92.9	93.7	94.1
-20	85.6	87.9	88.8	89.6	90.3	90.5	90.8	90.4	90.1	90.0	90.6	91.3	91.7	92.0	92.8	93.2
-25	84.7	87.1	88.0	88.7	89.4	89.6	89.9	89.5	89.2	89.1	89.7	90.4	90.8	91.1	91.9	92.2
-30	83.9	86.2	87.1	87.8	88.5	88.7	89.0	88.6	88.3	88.2	88.7	89.4	89.9	90.2	91.0	91.3
-35	83.0	85.3	86.2	86.9	87.6	87.8	88.0	87.7	87.4	87.3	87.8	88.5	89.0	89.2	90.0	90.4
-40	82.1	84.4	85.3	85.9	86.6	86.8	87.1	86.8	86.5	86.4	86.9	87.6	88.0	88.3	89.1	89.4

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	-0.4	-0.6	-0.6	-0.6	-0.6	-0.4	-0.3	-0.3	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1
ENGINE & WING*	-0.5	-0.8	-0.8	-0.8	-0.8	-0.6	-0.5	-0.5	-0.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.5	-0.4
ENGINE & WING**	-0.6	-0.9	-1.0	-1.0	-1.0	-0.9	-0.8	-0.8	-0.7	-0.7	-0.7	-0.7	-0.7	-0.8	-0.8	-0.8

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

ALTERNATE MODE EEC**ENGINE INOP****Max Continuous %N1****Based on engine bleed for packs on or off and anti-ice off****280 KIAS**

TAT (°C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	93.2	93.6	93.4	92.9	92.6	91.8	91.1	90.7	90.3	90.1	89.9	90.0	90.4	91.1	91.8	91.8
25	93.2	94.5	94.3	93.8	93.2	92.3	91.7	91.4	91.1	90.8	90.1	89.6	89.6	90.3	91.1	91.0
20	92.4	95.4	95.3	94.8	94.3	93.2	92.2	91.9	91.5	91.4	90.8	90.3	90.2	90.4	90.5	90.6
15	91.7	94.8	95.8	95.9	95.5	94.3	93.3	92.6	92.0	91.8	91.2	90.9	90.8	91.0	91.2	91.3
10	90.9	94.0	94.9	95.8	96.6	95.6	94.6	93.6	92.8	92.5	91.8	91.3	91.3	91.6	91.8	91.9
5	90.0	93.1	94.1	94.9	95.7	95.8	95.8	94.8	93.7	93.3	92.5	92.0	91.9	92.1	92.3	92.3
0	89.2	92.3	93.3	94.1	94.8	95.0	95.2	95.2	94.9	94.3	93.4	92.9	92.7	92.9	93.1	93.0
-5	88.4	91.4	92.4	93.2	94.0	94.1	94.3	94.4	94.4	94.3	94.4	93.9	93.7	93.9	94.1	94.0
-10	87.6	90.6	91.5	92.3	93.1	93.2	93.4	93.5	93.5	93.4	93.5	93.8	94.5	95.0	95.2	95.0
-15	86.8	89.7	90.7	91.5	92.2	92.3	92.5	92.6	92.6	92.5	92.6	92.9	93.6	94.7	95.8	95.5
-20	85.9	88.8	89.8	90.6	91.3	91.4	91.6	91.7	91.7	91.6	91.7	92.0	92.7	93.8	94.9	94.5
-25	85.1	88.0	88.9	89.7	90.4	90.5	90.7	90.8	90.8	90.7	90.8	91.1	91.8	92.8	93.9	93.6
-30	84.2	87.1	88.0	88.8	89.5	89.6	89.8	89.9	89.9	89.8	89.9	90.2	90.8	91.9	93.0	92.6
-35	83.3	86.2	87.1	87.8	88.6	88.7	88.8	88.9	88.9	88.9	89.0	89.3	89.9	91.0	92.0	91.7
-40	82.4	85.3	86.2	86.9	87.6	87.7	87.9	88.0	88.0	87.9	88.0	88.3	89.0	90.0	91.0	90.7

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	0.4	-0.7	-0.7	-0.7	-0.6	-0.4	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1
ENGINE & WING*	-0.5	-0.8	-0.9	-0.9	-0.8	-0.7	-0.5	-0.6	-0.5	-0.5	-0.5	-0.5	-0.4	-0.4	-0.5	-0.5
ENGINE & WING**	-0.6	-1.0	-1.0	-1.1	-1.1	-0.9	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.7	-0.9	-1.0

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

ALTERNATE MODE EEC

ENGINE INOP

Max Continuous %N1

Based on engine bleed for packs on or off and anti-ice off

240 KIAS

TAT (°C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	92.1	91.9	91.9	91.8	91.8	90.7	89.4	89.4	90.0	90.4	90.5	90.3	90.3	90.6	91.1	91.6
25	92.8	92.9	92.8	92.4	92.4	91.5	90.4	89.8	89.5	89.6	89.7	89.6	89.6	89.8	90.3	90.8
20	92.3	93.8	93.7	93.4	93.1	92.2	91.2	90.6	90.3	90.1	89.4	88.8	88.8	89.0	89.6	90.0
15	91.5	94.4	94.7	94.5	94.3	93.2	91.9	91.3	90.9	90.8	90.0	89.2	88.5	88.3	88.8	89.3
10	90.7	93.6	94.9	95.6	95.6	94.5	93.1	92.1	91.5	91.4	90.4	89.6	89.1	88.8	88.7	89.1
5	89.9	92.7	94.0	95.1	96.4	95.9	94.6	93.3	92.4	92.1	90.9	89.9	89.5	89.4	89.4	89.8
0	89.1	91.9	93.2	94.3	95.5	96.0	95.9	94.6	93.5	93.1	91.7	90.5	89.8	89.9	90.0	90.4
-5	88.3	91.1	92.3	93.4	94.6	95.1	95.2	95.1	94.7	94.3	92.7	91.4	90.6	90.6	90.6	91.1
-10	87.4	90.2	91.4	92.5	93.7	94.2	94.3	94.3	94.4	94.5	93.9	92.5	91.5	91.6	91.6	92.3
-15	86.6	89.4	90.6	91.7	92.8	93.3	93.4	93.4	93.5	93.6	93.3	93.0	92.8	92.8	92.8	93.4
-20	85.8	88.5	89.7	90.8	91.9	92.4	92.5	92.4	92.6	92.7	92.4	92.1	92.3	93.5	94.1	94.8
-25	84.9	87.6	88.8	89.9	91.0	91.5	91.6	91.5	91.6	91.8	91.4	91.2	91.4	92.5	93.7	94.6
-30	84.1	86.7	87.9	89.0	90.1	90.5	90.6	90.6	90.7	90.8	90.5	90.3	90.5	91.6	92.7	93.6
-35	83.2	85.8	87.0	88.0	89.2	89.6	89.7	89.7	89.8	89.9	89.6	89.4	89.5	90.6	91.7	92.7
-40	82.3	84.9	86.1	87.1	88.2	88.7	88.8	88.7	88.8	89.0	88.6	88.4	88.6	89.7	90.8	91.7

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	-0.4	-0.7	-0.7	-0.7	-0.6	-0.5	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1
ENGINE & WING*	-0.5	-0.8	-0.9	-0.9	-0.8	-0.7	-0.5	-0.6	-0.6	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.6
ENGINE & WING**	-0.6	-1.0	-1.0	-1.2	-1.1	-1.0	-0.8	-0.9	-0.9	-0.8	-0.8	-0.8	-0.9	-0.9	-0.9	-1.0

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

ALTERNATE MODE EEC**ENGINE INOP****Max Continuous %N1****Based on engine bleed for packs on or off and anti-ice off****200 KIAS**

TAT (°C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	91.6	90.6	90.3	89.8	89.4	88.2	87.9	88.7	89.3	89.6	89.3	89.2	89.3	89.7	89.9	90.4
25	92.4	91.4	90.9	90.4	90.1	89.1	87.8	87.9	88.6	88.9	88.6	88.5	88.6	89.0	89.1	89.7
20	92.7	92.3	91.8	91.1	90.7	89.9	88.9	88.4	87.9	88.1	87.8	87.7	87.9	88.2	88.4	88.9
15	91.9	93.2	92.7	92.1	91.5	90.5	89.8	89.3	88.8	88.6	87.3	87.0	87.1	87.5	87.6	88.2
10	91.1	93.2	93.6	93.0	92.5	91.6	90.6	90.0	89.5	89.3	88.2	87.1	86.3	86.7	86.8	87.4
5	90.3	92.4	93.2	93.9	93.6	92.7	91.8	90.9	90.1	89.9	88.8	87.8	86.9	86.6	86.1	86.6
0	89.4	91.6	92.3	93.0	93.9	94.0	93.2	92.1	91.1	90.6	89.3	88.3	87.4	87.3	86.8	87.1
-5	88.6	90.7	91.5	92.2	93.1	93.6	94.3	93.5	92.3	91.7	90.2	88.9	87.8	87.8	87.5	87.8
-10	87.8	89.9	90.6	91.3	92.2	92.8	93.4	93.8	93.6	93.0	91.3	89.8	88.5	88.3	88.0	88.4
-15	87.0	89.0	89.7	90.4	91.3	91.9	92.5	92.9	93.2	93.3	92.6	90.8	89.4	89.2	88.9	89.3
-20	86.1	88.1	88.9	89.6	90.4	91.0	91.6	92.0	92.3	92.4	92.1	91.7	90.6	90.3	90.0	90.5
-25	85.3	87.3	88.0	88.7	89.5	90.1	90.7	91.1	91.4	91.5	91.1	90.8	90.5	91.6	91.3	91.8
-30	84.4	86.4	87.1	87.8	88.6	89.2	89.8	90.2	90.4	90.5	90.2	89.9	89.6	90.7	91.7	92.6
-35	83.5	85.5	86.2	86.9	87.7	88.3	88.8	89.2	89.5	89.6	89.3	89.0	88.7	89.7	90.7	91.6
-40	82.6	84.6	85.3	86.0	86.8	87.3	87.9	88.3	88.6	88.7	88.3	88.0	87.8	88.8	89.8	90.6

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	-0.4	-0.7	-0.7	-0.7	-0.6	-0.5	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1
ENGINE & WING*	-0.5	-0.8	-0.9	-0.9	-0.9	-0.7	-0.5	-0.6	-0.5	-0.5	-0.6	-0.5	-0.5	-0.5	-0.6	-0.6
ENGINE & WING**	-0.6	-1.0	-1.1	-1.1	-1.1	-1.0	-0.8	-0.9	-0.9	-0.8	-0.9	-0.9	-0.9	-1.0	-1.0	-1.0

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

Intentionally
Blank

Performance Inflight

Gear Down

Chapter PI

Section 26

GEAR DOWN

220 KIAS Max Climb EPR

TAT (°C)	PRESSURE ALTITUDE (1000 FT)														
	0	5	10	12	14	16	18	20	22	24	26	28	30	32	34
55	1.187	1.185	1.206	1.210	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
50	1.204	1.199	1.206	1.210	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
45	1.223	1.219	1.206	1.210	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
40	1.243	1.239	1.229	1.218	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
35	1.264	1.262	1.253	1.243	1.233	1.223	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
30	1.280	1.286	1.276	1.268	1.259	1.250	1.243	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
25	1.280	1.311	1.303	1.293	1.284	1.276	1.271	1.267	1.259	1.262	1.260	1.251	1.246	1.235	1.225
20	1.280	1.323	1.331	1.321	1.312	1.304	1.299	1.296	1.290	1.280	1.260	1.251	1.246	1.235	1.225
15	1.280	1.323	1.360	1.350	1.342	1.334	1.329	1.326	1.321	1.313	1.293	1.264	1.246	1.235	1.225
10	1.280	1.323	1.366	1.377	1.373	1.366	1.362	1.359	1.352	1.345	1.325	1.295	1.270	1.246	1.225
5	1.280	1.323	1.366	1.377	1.391	1.399	1.396	1.394	1.389	1.380	1.359	1.326	1.298	1.276	1.256
0	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.431	1.426	1.419	1.397	1.359	1.325	1.306	1.292
-5	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.468	1.461	1.439	1.401	1.363	1.337	1.327
-10	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.474	1.495	1.484	1.444	1.406	1.381	1.369
-15	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.474	1.495	1.501	1.491	1.454	1.427	1.417
-20	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.474	1.495	1.501	1.491	1.480	1.480	1.469

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)							
	0	5	10	15	20	25	30	35
ENGINE ONLY	-0.008	-0.010	-0.015	-0.014	-0.006	-0.005	-0.003	-0.003
ENGINE AND WING*	-0.010	-0.012	-0.018	-0.019	-0.012	-0.012	-0.011	-0.013
ENGINE AND WING**	-0.012	-0.014	-0.021	-0.024	-0.018	-0.019	-0.020	-0.023

*Wing anti-ice on, packs on.

**Wing anti-ice on, single bleed source and both packs off.

Long Range Cruise Altitude Capability

Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
300	13000	10400	7300
280	16200	13700	11000
260	19500	17200	14600
240	22500	20500	18200
220	25300	23600	21700
200	27300	26100	25000
180	29400	28200	27100
160	32100	30500	29300
140	35700	34000	32300

GEAR DOWN

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
300	EPR	1.240									
	MACH	.488									
	KIAS	270									
	FF/ENG	7412									
280	EPR	1.216	1.292	1.334							
	MACH	.474	.518	.538							
	KIAS	262	261	261							
	FF/ENG	6899	6901	6969							
260	EPR	1.192	1.261	1.295	1.338						
	MACH	.458	.501	.519	.540						
	KIAS	253	252	252	252						
	FF/ENG	6367	6344	6363	6431						
240	EPR	1.169	1.231	1.261	1.296	1.340	1.395				
	MACH	.441	.484	.501	.520	.541	.563				
	KIAS	244	243	243	242	242	242				
	FF/ENG	5839	5818	5811	5829	5893	5962				
220	EPR	1.147	1.202	1.229	1.259	1.295	1.339	1.394			
	MACH	.422	.465	.482	.500	.519	.541	.563			
	KIAS	233	234	233	233	232	232	232			
	FF/ENG	5304	5300	5291	5283	5299	5356	5419			
200	EPR	1.127	1.174	1.197	1.224	1.255	1.290	1.334	1.389		
	MACH	.402	.445	.462	.480	.498	.517	.538	.561		
	KIAS	222	223	223	223	222	222	222	222		
	FF/ENG	4772	4784	4779	4771	4763	4773	4820	4879		
180	EPR	1.110	1.147	1.167	1.190	1.218	1.247	1.281	1.324	1.378	
	MACH	.387	.422	.439	.457	.475	.493	.512	.534	.557	
	KIAS	213	212	212	212	212	211	211	211	211	
	FF/ENG	4327	4262	4268	4264	4257	4249	4252	4286	4341	
160	EPR	1.094	1.125	1.141	1.160	1.185	1.211	1.240	1.275	1.317	1.369
	MACH	.372	.403	.419	.436	.454	.472	.492	.513	.535	.558
	KIAS	205	202	202	202	202	202	202	202	202	202
	FF/ENG	3925	3818	3812	3805	3799	3797	3802	3815	3845	3887
140	EPR	1.079	1.106	1.120	1.136	1.157	1.180	1.205	1.233	1.267	1.308
	MACH	.352	.387	.403	.419	.436	.454	.473	.493	.515	.537
	KIAS	194	194	194	194	194	194	194	194	194	194
	FF/ENG	3474	3496	3491	3486	3475	3468	3407	3409	3419	3444

GEAR DOWN

**Long Range Cruise Enroute Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
324	290	260	236	217	200	189	179	170	161	154
656	584	523	474	435	400	378	357	339	323	308
991	882	788	714	653	600	567	536	509	484	462
1329	1181	1053	953	871	800	755	714	677	644	615
1670	1482	1320	1193	1090	1000	943	892	845	804	767
2014	1785	1589	1434	1309	1200	1132	1070	1014	964	919
2362	2091	1859	1676	1528	1400	1320	1248	1182	1123	1071
2715	2400	2130	1919	1748	1600	1508	1425	1349	1282	1223
3073	2711	2403	2163	1968	1800	1696	1602	1517	1441	1373
3434	3026	2678	2407	2189	2000	1884	1779	1684	1599	1524
3799	3343	2954	2652	2410	2200	2072	1955	1850	1756	1674
4169	3662	3232	2898	2631	2400	2259	2132	2016	1914	1824
4542	3984	3511	3145	2853	2600	2447	2308	2183	2071	1974
4921	4309	3792	3393	3075	2800	2635	2485	2349	2229	2123
5303	4637	4074	3641	3297	3000	2822	2661	2515	2386	2272
5689	4968	4358	3890	3519	3200	3010	2837	2681	2542	2421
6081	5301	4643	4140	3742	3400	3197	3012	2846	2698	2569
6477	5638	4930	4391	3966	3600	3384	3188	3011	2854	2717
6877	5977	5220	4643	4190	3800	3571	3363	3176	3010	2865
7283	6320	5510	4896	4414	4000	3758	3538	3340	3165	3012

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	6.7	0:49	6.1	0:47	5.3	0:44	4.8	0:42	4.4	0:40
400	13.9	1:37	12.9	1:31	11.5	1:24	10.7	1:20	10.1	1:16
600	21.0	2:25	19.5	2:17	17.5	2:06	16.4	1:59	15.6	1:53
800	27.9	3:15	26.0	3:04	23.4	2:48	22.0	2:39	20.9	2:30
1000	34.7	4:04	32.4	3:51	29.3	3:30	27.5	3:19	26.2	3:07
1200	41.3	4:55	38.6	4:40	35.0	4:14	32.9	3:59	31.3	3:45
1400	47.8	5:46	44.7	5:28	40.6	4:58	38.2	4:40	36.3	4:23
1600	54.2	6:38	50.8	6:17	46.2	5:42	43.4	5:22	41.3	5:02
1800	60.5	7:31	56.7	7:07	51.7	6:27	48.5	6:03	46.1	5:41
2000	66.7	8:24	62.6	7:57	57.2	7:12	53.6	6:45	51.0	6:20
2200	72.9	9:19	68.3	8:48	62.4	7:58	58.5	7:28	55.6	7:00
2400	79.0	10:14	74.0	9:39	67.7	8:44	63.4	8:11	60.2	7:39
2600	85.1	11:10	79.5	10:31	72.8	9:31	68.2	8:54	64.8	8:20
2800	91.0	12:07	85.0	11:24	77.8	10:18	73.0	9:38	69.2	9:01
3000	96.9	13:04	90.4	12:17	82.8	11:06	77.7	10:22	73.6	9:41
3200	102.5	14:03	95.7	13:12	87.6	11:54	82.3	11:07	77.9	10:23
3400	108.1	15:02	101.0	14:06	92.4	12:43	86.8	11:53	82.2	11:05
3600	113.6	16:02	106.2	15:02	97.1	13:33	91.3	12:38	86.4	11:47
3800	119.0	17:04	111.3	15:58	101.7	14:23	95.6	13:24	90.5	12:30
4000	124.4	18:05	116.4	16:54	106.3	15:13	100.0	14:11	94.7	13:13

GEAR DOWN

**Long Range Cruise Enroute Fuel and Time
Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)							
	160	180	200	220	240	260	280	300
10	-1.4	-0.7	0.0	0.8	2.0	3.5	5.4	7.6
20	-2.1	-1.1	0.0	1.6	3.7	6.3	9.4	13.1
30	-2.9	-1.5	0.0	2.3	5.3	8.9	13.2	18.1
40	-3.7	-1.9	0.0	3.0	6.8	11.4	16.6	22.7
50	-4.6	-2.4	0.0	3.7	8.2	13.6	19.8	26.8
60	-5.4	-2.8	0.0	4.3	9.5	15.6	22.6	30.5
70	-6.3	-3.3	0.0	4.9	10.7	17.5	25.1	33.7
80	-7.2	-3.7	0.0	5.5	11.8	19.1	27.4	36.5
90	-8.1	-4.2	0.0	6.0	12.8	20.6	29.3	38.8
100	-9.1	-4.7	0.0	6.4	13.7	21.9	30.9	40.7
110	-10.1	-5.1	0.0	6.9	14.5	22.9	32.1	42.1
120	-11.1	-5.6	0.0	7.3	15.2	23.8	33.1	43.1
130	-12.1	-6.1	0.0	7.6	15.8	24.5	33.8	43.6

Descent at VREF30+80

PRESSURE ALT (1000 FT)	17	19	21	23	25	27	29	31	33	35
DISTANCE (NM)	41	45	49	53	57	61	65	69	73	78
TIME (MINUTES)	12	12	13	14	15	16	16	17	18	18

GEAR DOWN

**Holding
Flaps Up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
300	EPR	1.138	1.167	1.227	1.313			
	KIAS	244	244	244	244			
	FF/ENG	7090	7090	7110	7210			
280	EPR	1.123	1.150	1.203	1.278			
	KIAS	239	239	239	239			
	FF/ENG	6610	6620	6620	6670			
260	EPR	1.110	1.134	1.179	1.247	1.345		
	KIAS	234	234	234	234	234		
	FF/ENG	6160	6150	6150	6180	6300		
240	EPR	1.097	1.119	1.158	1.217	1.302		
	KIAS	228	228	228	228	228		
	FF/ENG	5720	5690	5690	5690	5750		
220	EPR	1.086	1.104	1.140	1.190	1.263	1.376	
	KIAS	222	222	222	222	222	222	
	FF/ENG	5290	5260	5240	5230	5250	5390	
200	EPR	1.076	1.092	1.123	1.166	1.230	1.322	
	KIAS	215	215	215	215	215	215	
	FF/ENG	5000	4840	4810	4790	4800	4860	
180	EPR	1.067	1.081	1.106	1.144	1.199	1.277	1.402
	KIAS	208	208	208	208	208	208	208
	FF/ENG	4600	4440	4390	4380	4370	4390	4510
160	EPR	1.059	1.071	1.093	1.126	1.173	1.242	1.345
	KIAS	203	203	203	203	203	203	203
	FF/ENG	4270	4220	4060	4040	4030	4030	4100
140	EPR	1.053	1.064	1.084	1.114	1.157	1.219	1.310
	KIAS	203	203	203	203	203	203	203
	FF/ENG	4110	4060	3900	3870	3910	3830	3870

This table includes 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN

Holding
Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
300	EPR	1.140	1.168	1.225	1.307	
	KIAS	224	224	224	224	
	FF/ENG	6760	6760	6760	6820	
280	EPR	1.126	1.153	1.202	1.276	1.384
	KIAS	219	219	219	219	219
	FF/ENG	6320	6310	6300	6330	6470
260	EPR	1.113	1.137	1.181	1.247	1.342
	KIAS	214	214	214	214	214
	FF/ENG	5890	5870	5860	5880	5960
240	EPR	1.101	1.122	1.161	1.218	1.301
	KIAS	208	208	208	208	208
	FF/ENG	5460	5430	5420	5410	5450
220	EPR	1.090	1.107	1.143	1.191	1.264
	KIAS	202	202	202	202	202
	FF/ENG	5030	4990	4970	4960	4980
200	EPR	1.080	1.095	1.125	1.167	1.229
	KIAS	195	195	195	195	195
	FF/ENG	4730	4570	4530	4530	4530
180	EPR	1.069	1.083	1.107	1.144	1.196
	KIAS	188	188	188	188	188
	FF/ENG	4310	4270	4110	4100	4090
160	EPR	1.059	1.072	1.093	1.125	1.169
	KIAS	183	183	183	183	183
	FF/ENG	3960	3920	3770	3800	3790
140	EPR	1.053	1.064	1.083	1.111	1.151
	KIAS	183	183	183	183	183
	FF/ENG	3770	3720	3640	3600	3580

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight
Gear Down, Engine INOP

Chapter PI
Section 27

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		VREF + 80 DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
260	246	233	2200		
240	228	227	5600	3300	400
220	210	221	8500	6600	4200
200	191	214	11300	9700	7500
180	172	208	14100	12500	10700
160	153	200	16800	15400	13700
140	134	192	19500	18100	16500

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
240	3500		
220	6900	4800	1700
200	10100	8100	5800
180	13000	11300	9300
160	15900	14400	12500
140	18700	17200	15700

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)						
		5	7	9	11	13	15	17
240	EPR	1.394						
	MACH	.379						
	KIAS	229						
	FF/ENG	10859						
230	EPR	1.372	1.420					
	MACH	.374	.388					
	KIAS	226	226					
	FF/ENG	10399	10514					
220	EPR	1.350	1.395					
	MACH	.369	.382					
	KIAS	223	223					
	FF/ENG	9949	10039					
210	EPR	1.330	1.371	1.420				
	MACH	.363	.377	.391				
	KIAS	220	220	220				
	FF/ENG	9514	9582	9688				
200	EPR	1.310	1.348	1.393	1.447			
	MACH	.358	.371	.385	.400			
	KIAS	216	216	216	216			
	FF/ENG	9096	9139	9222	9351			
190	EPR	1.291	1.326	1.367	1.417	1.478		
	MACH	.352	.365	.379	.393	.408		
	KIAS	213	213	213	213	213		
	FF/ENG	8689	8712	8774	8870	9037		
180	EPR	1.273	1.305	1.343	1.388	1.442		
	MACH	.346	.359	.373	.387	.402		
	KIAS	209	209	209	209	209		
	FF/ENG	8291	8303	8340	8414	8529		
170	EPR	1.255	1.285	1.320	1.361	1.409	1.470	
	MACH	.340	.353	.366	.380	.395	.410	
	KIAS	206	206	206	206	206	206	
	FF/ENG	7892	7901	7919	7971	8055	8200	
160	EPR	1.238	1.266	1.298	1.335	1.379	1.432	1.500
	MACH	.334	.346	.359	.373	.388	.403	.419
	KIAS	202	202	202	202	202	202	202
	FF/ENG	7496	7504	7513	7541	7605	7701	7882
150	EPR	1.221	1.247	1.276	1.310	1.350	1.397	1.456
	MACH	.327	.340	.353	.366	.380	.395	.411
	KIAS	198	198	198	198	198	198	198
	FF/ENG	7109	7109	7116	7129	7168	7238	7355
140	EPR	1.205	1.228	1.256	1.287	1.323	1.365	1.416
	MACH	.321	.333	.345	.359	.373	.387	.403
	KIAS	194	194	194	194	194	194	194
	FF/ENG	6729	6721	6725	6732	6750	6799	6877

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
170	150	132	119	109	100	93	88	83	78	75
349	305	269	241	219	200	187	175	164	154	146
529	462	406	363	329	300	279	260	244	230	218
710	620	544	486	440	400	372	347	325	306	290
892	778	681	608	550	500	465	433	406	381	361
1075	936	819	730	660	600	558	520	487	458	433
1259	1096	958	853	771	700	651	606	567	533	504
1444	1256	1097	976	882	800	743	692	647	608	575
1630	1416	1236	1100	992	900	836	778	727	683	646
1817	1577	1375	1223	1103	1000	928	864	808	759	717

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	6		8		10		12		14	
	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME
	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)	(1000 KG)	(HR:MIN)
100	3.3	0:28	3.1	0:27	2.9	0:27	2.7	0:26	2.6	0:26
200	6.9	0:54	6.6	0:53	6.4	0:52	6.1	0:50	5.9	0:49
300	10.5	1:21	10.1	1:19	9.8	1:17	9.5	1:15	9.2	1:13
400	14.1	1:48	13.6	1:45	13.2	1:42	12.8	1:39	12.5	1:36
500	17.6	2:15	17.0	2:11	16.5	2:07	16.1	2:04	15.7	2:00
600	21.1	2:42	20.4	2:37	19.8	2:33	19.3	2:29	18.9	2:24
700	24.6	3:09	23.8	3:04	23.1	2:59	22.5	2:54	22.0	2:49
800	28.0	3:37	27.1	3:31	26.3	3:25	25.6	3:19	25.1	3:13
900	31.3	4:05	30.4	3:58	29.5	3:51	28.8	3:44	28.1	3:37
1000	34.7	4:33	33.6	4:25	32.7	4:17	31.8	4:09	31.2	4:02

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)					
	140	160	180	200	220	240
4	-0.4	-0.2	0.0	0.3	0.8	1.3
6	-0.7	-0.3	0.0	0.5	1.2	2.0
8	-0.9	-0.5	0.0	0.7	1.6	2.7
10	-1.2	-0.6	0.0	0.9	2.0	3.3
12	-1.4	-0.7	0.0	1.0	2.4	4.0
14	-1.7	-0.8	0.0	1.2	2.7	4.6
16	-1.9	-1.0	0.0	1.4	3.1	5.2
18	-2.1	-1.1	0.0	1.5	3.5	5.8
20	-2.4	-1.2	0.0	1.7	3.8	6.4
22	-2.6	-1.3	0.0	1.8	4.1	7.0
24	-2.9	-1.4	0.0	2.0	4.5	7.5
26	-3.1	-1.6	0.0	2.1	4.8	8.0
28	-3.3	-1.7	0.0	2.3	5.1	8.5
30	-3.6	-1.8	0.0	2.4	5.4	9.0
32	-3.8	-1.9	0.0	2.6	5.7	9.5
34	-4.1	-2.0	0.0	2.7	6.0	10.0
36	-4.3	-2.2	0.0	2.8	6.2	10.4

Holding Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)			
		1500	5000	10000	15000
240	EPR	1.319	1.390		
	KIAS	228	228		
	FF/ENG	11170	11310		
220	EPR	1.285	1.347		
	KIAS	222	222		
	FF/ENG	10300	10360		
200	EPR	1.253	1.307	1.414	
	KIAS	215	215	215	
	FF/ENG	9440	9470	9650	
180	EPR	1.223	1.270	1.360	
	KIAS	208	208	208	
	FF/ENG	8620	8620	8700	
160	EPR	1.199	1.240	1.319	1.437
	KIAS	203	203	203	203
	FF/ENG	7950	7940	7970	8170
140	EPR	1.185	1.222	1.295	1.401
	KIAS	203	203	203	203
	FF/ENG	7590	7570	7590	7720

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight**Text****Chapter PI****Section 28**

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer. In addition, sufficient inflight data is provided to complete a flight with the FMC inoperative. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General**FMC Takeoff Speeds**

FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Clearway and Stopway V1 Adjustments

Takeoff speed corrections are to be applied to V1 when using takeoff weights based on the use of clearway and stopway.

Adjust V1 by the amount shown in the table. The adjusted V1 must not exceed VR. If V1 is greater than VR, VR may be increased to equal V1. The resultant V2 will be increased by the same amount that VR was increased.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF Speeds

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver speeds. Using VREF as the basis for the schedule makes it variable as a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assume an engine failure at the critical point during the takeoff.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush depths greater than 13mm (0.5 inches) are not recommended because of possible airplane damage as a result of slush impingement on the airplane structure. The use of assumed temperature for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight is determined as follows:

- (1) Determine the dry field/obstacle limit weight for the takeoff flap setting.
- (2) Enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.
- (3) Adjust field length available for temperature by amount shown on chart.

(4) Enter the V1(MCG) Limit Weight table with the field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

(1) Determine takeoff speeds V1, VR and V2 for actual brake release weight using Takeoff Speeds from the Performance Dispatch chapter or from the FMC.

(2) If V1(MCG) limited, set $V1 = V1(MCG)$. If not limited by V1(MCG) considerations, enter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than V1(MCG), set $V1 = V1(MCG)$.

Slippery Runway

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on reversers operating and a 15 ft screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Go-Around EPR

To find Go-Around EPR based on normal engine bleed for packs on and anti-ice off, enter the Go-Around EPR table with airport pressure altitude and reported OAT or TAT and read EPR. EPR adjustments are shown for engine bleeds for various conditions.

Max Climb EPR

This table shows Max Climb EPR for a 310/.84 climb speed schedule, normal engine bleed for packs on and anti-ice off. Enter the table with airport pressure altitude and TAT and read EPR. EPR adjustments are shown for anti-ice operation.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Body attitude and average EPR information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome may also cause unreliable airspeed/Mach indications. Climb, cruise and descent information is based on the recommended turbulent air penetration speed schedule: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and above; maintain a minimum speed of 15 knots above the minimum maneuvering speed when below 0.82 Mach. This schedule provides ample protection from stall and high speed buffet, while also providing protection from exceeding structural limits.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Control

These tables provide target EPR, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude, .84 Mach approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .84/310/250 descent. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent at .84/310/250

Distance and time for descent are shown for a .84/310/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing Flaps 30 at the outer marker.

Holding

Target EPR, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the FMC optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed for the selected flap setting. Flaps 1 is based on VREF30+60 speed schedule. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read EPR, IAS and fuel flow per engine.

Advisory Information

Normal Configuration Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and slippery runways with good, medium, and poor reported braking action. These values are actual landing distances and do not include the 1.67 regulatory factor. Therefore, they cannot be used to determine the dispatch required landing field length.

To use these tables, determine the reference landing distance for the selected braking configuration. Then adjust the reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers to obtain the actual landing distance.

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. If the surface is affected by water, snow, or ice, and the braking action is reported as "good", conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate "poor" data reflects runways covered with wet ice.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" braking action, the airplane may not be able to achieve these deceleration rates. In these cases, runway slope and inoperative reversers influence the stopping distance. Since it cannot be determined quickly when this becomes a factor, it is appropriate to add the effects of slope and inoperative reversers when using the autobrake system.

Non-Normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances and adjustments are provided for dry runways and runways with good, medium, and poor reported braking action.

Enter the table with the applicable non-normal configuration and read the normal approach speed. The reference landing distance is a reference distance from 50 ft above the threshold to stop based on a reference landing weight and speed at sea level, zero wind, and zero slope. Subsequent columns provide corrections for off-reference landing weight, altitude, wind, slope, and speed conditions. Each corrections is independently added to the reference landing distance. Landing distance includes the effects of max manual braking and reverse thrust.

For an engine inoperative autoland, check the rate of climb capability shown in Gear Down Landing Rate of Climb Available tables to ensure adequate climb performance.

Landing Climb Limit Weight

In the event an overweight landing is necessary and the fuel dump system is unavailable, landing climb limits should be checked if a Flaps 25 or 30 landing is planned. Enter the table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required. At weights exceeding those shown, plan a Flaps 20 landing.

Recommended Brake Cooling Schedule

Advisory information is provided to assist in avoiding problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Recommended Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind, at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the appropriate Event Adjusted Brake Energy Table (No Reverse Thrust or 2 Engine Reverse) with the reference brake energy per brake and the type of

braking used during landing (Max Manual, Max Auto, or Autobrake). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing. The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Brake Temperature Monitor System (BTMS) indications are also shown. If brake cooling is determined from the BTMS, the hottest brake indication 10 to 15 minutes after the airplane has come to a complete stop, or inflight with gear retracted, may be used to determine recommended cooling schedule by entering at the bottom of the chart. An EICAS advisory message, BRAKE TEMP, will appear when any brake registers 5.0 or higher on the EICAS indication and disappear as the hottest brake cools with an EICAS indication of 3.5. Note that even without an EICAS advisory message, brake cooling is recommended.

Engine Inoperative

Initial Max Continuous EPR

The Initial Max Continuous EPR setting for use following an engine failure is shown. The table is based on the typical all engine cruise Mach number of .84 to provide a target EPR setting at the start of driftdown. Once driftdown is established, the Max Continuous EPR table should be used to determine EPR for the given conditions.

Max Continuous EPR

Power setting is based on one engine operating with one bleed source for pack(s) operating and all anti-ice bleeds off. Enter the table for appropriate pressure altitude with IAS or Mach and TAT to read Max Continuous EPR. Apply the anti-ice corrections below the table as required.

It is desirable to maintain engine thrust level within the limits of the Max Cruise thrust rating. However, where thrust level in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/Cruise Range Capability

This table shows the range capability from the start of driftdown.

Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to long range cruise speed. Cruise is continued at level off altitude and long range cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and correct for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required. If altitudes other than the level off altitude is used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

Table show the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on LRC speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target EPR, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (KG/HR)				
	GROSS WEIGHT (1000 KG)				
	300	260	220	180	140
43				160	140
39			180	160	145
35		200	190	170	140
31	230	220	195	165	140
25	230	220	195	175	155
20	235	230	205	185	165
15	235	235	215	200	185
10	240	240	230	220	200
5	270	270	255	240	220

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on single engine Long Range Cruise speed and .84/310/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion Table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the off reference fuel corrections table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down Landing Rate of Climb Available

Rate of climb data is provided as guidance information in the event an engine inoperative autoland is planned. The tables show gear down rate of climb available for Flaps 20 and Flaps 30. Enter the table with TAT and pressure altitude to read rate of climb available. Apply adjustments shown to correct for weight.

Alternate Mode EEC

Limit Weight

A simplified method which conservatively accounts for the effects of EEC in the ALTERNATE mode is to reduce the PRIMARY mode (normal) performance limited weights. The Limit Weight table provides takeoff field, climb, obstacle, net level off and landing climb weights. To determine limit weights for operations with the EEC in the ALTERNATE mode, enter the table with the limit weights for PRIMARY mode EEC operation and read the associated limit weight for each performance condition. The most limiting of the takeoff weights must be used. The ALTERNATE Mode EEC Landing Climb limit must be compared to the Landing Field Length limit and the more limiting of the two must be used as the landing limit weight. Analysis from the Airplane Flight Manual - Digital Performance Information may yield less restrictive limit weights.

Takeoff Speed Adjustment

Takeoff speeds for the reduced weight should be increased by the amount shown in the Takeoff Speeds Adjustments Table. The adjusted V1 should not exceed the adjusted VR.

NOTE: The FMC does incorporate ALTERNATE Mode EEC performance in its takeoff speeds calculations.

Max Takeoff %N1

Takeoff power settings are presented for normal air condition bleed. Max Takeoff %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode and maximum rated thrust is reached at a thrust lever position less than full forward. As a result, thrust overboost can occur at full forward thrust lever positions.

Max Climb %N1

This table shows Max Climb %N1 for a 310/.84 climb speed schedule with anti-ice off. Enter the table with pressure altitude and TAT to read Max Climb %N1. Apply bleed adjustments as required.

Max Cruise %N1

Maximum Cruise %N1 is presented for .84M, which approximates Long Range Cruise speed. Enter the table with pressure altitude and TAT to read Max Cruise %N1. Appropriate bleed adjustments are shown.

Go-Around %N1

Go-Around power setting for ALTERNATE MODE EEC operation is presented for normal engine bleed for packs on. Go-Around %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode and maximum rated thrust is reached at a thrust lever position less than full forward. As a result, thrust overboost can occur at full forward thrust lever positions.

Alternate Mode EEC, Engine Inoperative

Initial Max Continuous %N1

Initial Max Continuous %N1 settings for use following an engine failure are presented. The table is based on the typical all engine cruise Mach number of .84 to provide a target %N1 setting at the start of driftdown. Appropriate bleed adjustments are shown. Once driftdown is established, the Max Continuous %N1 table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Max Continuous %N1 settings are presented as a function of pressure altitude and TAT for engine inoperative speeds of 320, 280, 240, and 200 KIAS. Power settings may be interpolated for intermediate airspeeds. Apply bleed adjustments as required.

Gear Down

This section contains performance for airplane operation with the landing gear extended for all phases of flight. The data is based on engine bleeds for normal air conditioning.

Note: The Flight Management Computer System (FMCS) does not contain special provisions for operation with landing gear extended. As a result, the FMCS will generate inaccurate enroute speed schedules, display non-conservative predictions of fuel burn, estimated time of arrival (ETA), maximum altitude, and compute overly shallow descent path. To obtain accurate ETA predictions, gear down cruise speed and altitude should be entered on the CLB and CRZ pages. Gear down cruise speed should also be entered on the DES page and a STEP SIZE of zero should be entered on the PERF INIT or CRZ page. Use of VNAV during descent under these circumstances is not recommended.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

Intentionally
Blank

Performance Inflight**Chapter PI****Table of Contents****Section 30****777-200LR GE90-110B1L KG FAA**

General	PI.30.1
Maximum Allowable Clearway	PI.30.1
Clearway and Stopway V1 Adjustments	PI.30.1
VREF	PI.30.2
Flap Maneuver Speed	PI.30.3
Slush/Standing Water Takeoff	PI.30.4
Slippery Runway Takeoff	PI.30.8
TO1 Slush/Standing Water Takeoff	PI.30.12
TO1 Slippery Runway Takeoff	PI.30.16
TO2 Slush/Standing Water Takeoff	PI.30.20
TO2 Slippery Runway Takeoff	PI.30.24
Minimum Control Speeds	PI.30.28
Go-around %N1	PI.30.29
Max Climb %N1	PI.30.30
Flight With Unreliable Airspeed / Turbulent Air Penetration	PI.30.31
All Engine	PI.31.1
Long Range Cruise Maximum Operating Altitude	PI.31.1
Long Range Cruise Control	PI.31.3
Long Range Cruise Enroute Fuel and Time - Low Altitude	PI.31.4
Long Range Cruise Enroute Fuel and Time - High Altitude	PI.31.5
Long Range Cruise Wind-Altitude Trade	PI.31.6
Descent at .84M/310/250	PI.31.6
Holding	PI.31.7
Advisory Information	PI.32.1
Normal Configuration Landing Distance	PI.32.1
Non-Normal Configuration Landing Distance	PI.32.5
Landing Climb Limit Weight	PI.32.9
Recommended Brake Cooling Schedule	PI.32.11

Engine Inoperative	PI.33.1
Initial Max Continuous %N1	PI.33.1
Max Continuous %N1	PI.33.2
Driftdown Speed/Level Off Altitude	PI.33.5
Driftdown/LRC Cruise Range Capability	PI.33.6
Long Range Cruise Altitude Capability	PI.33.7
Long Range Cruise Control	PI.33.8
Long Range Cruise Diversion Fuel and Time	PI.33.9
Holding	PI.33.10
Gear Down Landing Rate of Climb Available	PI.33.11
 Alternate Mode EEC	 PI.34.1
Alternate Mode EEC Max Takeoff %N1	PI.34.1
 Gear Down	 PI.35.1
220 KIAS Max Climb %N1	PI.35.1
Long Range Cruise Altitude Capability	PI.35.2
Long Range Cruise Control	PI.35.3
Long Range Cruise Enroute Fuel and Time	PI.35.4
Descent at VREF30 + 80	PI.35.5
Holding	PI.35.6
 Gear Down, Engine Inoperative	 PI.36.1
Driftdown Speed/Level Off Altitude	PI.36.1
Long Range Cruise Altitude Capability	PI.36.1
Long Range Cruise Control	PI.36.2
Long Range Cruise Diversion Fuel and Time	PI.36.3
Holding	PI.36.4
 Text	 PI.37.1
Introduction	PI.37.1
General	PI.37.1
All Engines	PI.37.4
Advisory Information	PI.37.6
Engine Inoperative	PI.37.8

777 Flight Crew Operations Manual

Alternate Mode EEC	PI.37.11
Gear Down	PI.37.11

Intentionally
Blank

Performance Inflight
General

Chapter PI
Section 30

Maximum Allowable Clearway

FIELD LENGTH (M)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (M)
1500	175
2000	220
2500	260
3000	300
3500	340
4000	400
4500	450

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (M)	NORMAL V1 (KIAS)							
	DRY RUNWAY				WET RUNWAY			
	100	120	140	160	100	120	140	160
300	-2	-3	-3	-3				
200	-2	-3	-3	-2				
100	-2	-2	-1	-1				
0	0	0	0	0	0	0	0	0
-100	4	4	3	2	3	2	2	1
-200	7	6	5	4	5	4	4	3
-300	7	6	5	5	7	6	5	4

VREF

Flaps 30

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
360	184	184	184	184	184	184
340	180	180	180	180	180	180
320	173	173	173	173	173	173
300	164	164	164	164	164	165
280	158	158	158	158	158	158
260	149	149	149	150	150	150
240	143	144	144	144	144	144
220	137	137	138	138	138	138
200	137	134	131	131	131	131
180	137	134	130	126	124	124
160	137	134	130	126	121	117

Flaps 25

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
360	183	183	183	183	183	183
340	180	180	180	180	181	181
320	175	175	175	175	175	176
300	169	170	170	170	170	170
280	164	164	164	164	164	164
260	158	158	158	158	158	158
240	152	152	152	152	152	152
220	145	145	146	146	146	146
200	139	139	139	139	139	139
180	137	134	131	131	131	132
160	137	134	130	126	124	124

Flaps 20

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
360	193	193	193	193	194	195
340	190	190	190	191	191	192
320	185	185	185	185	185	186
300	179	179	179	179	180	180
280	173	173	173	173	174	174
260	167	167	167	167	167	167
240	160	160	161	161	161	161
220	154	154	154	154	154	154
200	147	147	147	147	147	147
180	139	139	139	139	139	139
160	137	134	131	131	131	131

Flap Maneuver Speed

FLAP POSITION	MANEUVER SPEED
FLAPS 0	VREF30 + 80
FLAPS 1	VREF30 + 60
FLAPS 5	VREF30 + 40
FLAPS 15	VREF30 + 20
FLAPS 20	VREF30 + 20
FLAPS 25	VREF25
FLAPS 30	VREF30

ADVISORY INFORMATION

Slush/Standing Water Takeoff

Maximum Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-36.7	-41.6	-46.5	-43.6	-48.5	-53.4	-55.0	-59.9	-64.8
340	-34.6	-39.5	-44.4	-40.8	-45.7	-50.6	-51.0	-55.9	-60.8
320	-32.3	-37.2	-42.1	-37.8	-42.7	-47.6	-46.8	-51.7	-56.6
300	-29.7	-34.6	-39.5	-34.5	-39.4	-44.3	-42.4	-47.3	-52.2
280	-26.8	-31.7	-36.6	-31.0	-35.9	-40.8	-37.8	-42.7	-47.6
260	-23.7	-28.6	-33.5	-27.3	-32.2	-37.1	-32.9	-37.8	-42.7
240	-20.4	-25.3	-30.2	-23.3	-28.2	-33.1	-27.9	-32.8	-37.7
220	-16.9	-21.7	-26.6	-19.1	-24.0	-28.9	-22.6	-27.5	-32.4
200	-13.0	-17.9	-22.8	-14.7	-19.6	-24.5	-17.1	-22.0	-26.9
180	-9.0	-13.9	-18.8	-10.0	-14.9	-19.8	-11.4	-16.3	-21.2
160	-4.9	-9.7	-14.6	-5.3	-10.2	-15.1	-5.6	-10.5	-15.4

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2200				134.1			155.7		
2400	155.7			168.7			190.4		
2600	190.1			203.4	137.9		225.3	159.5	
2800	224.7	159.5		238.4	172.5		260.5	194.2	128.6
3000	259.8	193.9	128.9	273.8	207.2	141.7	296.0	229.2	163.3
3200	295.3	228.6	163.3	309.5	242.3	176.3	331.8	264.4	198.0
3400	331.3	263.7	197.7	345.7	277.7	211.1	367.9	299.9	233.0
3600	367.8	299.3	232.4	382.2	313.5	246.1		335.8	268.3
3800		335.3	267.6		349.7	281.6		371.9	303.9
4000		371.8	303.2			317.4			339.7
4200			339.3			353.7			375.9
4400			375.8						

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -65 m/+60 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

**Slush/Standing Water Takeoff
Maximum Reverse Thrust
V1 Adjustment (KIAS)**

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-26	-24	-22	-22	-20	-18	-14	-12	-10
340	-28	-26	-24	-23	-21	-19	-15	-13	-11
320	-29	-27	-25	-25	-23	-21	-16	-14	-12
300	-30	-28	-26	-26	-24	-22	-18	-16	-14
280	-31	-29	-27	-27	-25	-23	-20	-18	-16
260	-31	-29	-27	-28	-26	-24	-21	-19	-17
240	-31	-29	-27	-29	-27	-25	-23	-21	-19
220	-31	-29	-27	-29	-27	-25	-24	-22	-20
200	-31	-29	-27	-29	-27	-25	-25	-23	-21
180	-30	-28	-26	-28	-26	-24	-25	-23	-21
160	-29	-27	-25	-28	-26	-24	-25	-23	-21

- 1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
- 2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slush/Standing Water Takeoff

No Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-49.8	-54.9	-60.0	-57.7	-62.8	-67.9	-70.5	-75.6	-80.7
340	-46.7	-51.8	-56.8	-53.7	-58.8	-63.9	-64.9	-70.0	-75.1
320	-43.4	-48.4	-53.5	-49.6	-54.7	-59.8	-59.3	-64.3	-69.4
300	-39.9	-45.0	-50.0	-45.3	-50.4	-55.5	-53.6	-58.7	-63.8
280	-36.2	-41.3	-46.4	-40.9	-46.0	-51.1	-47.9	-53.0	-58.1
260	-32.4	-37.5	-42.6	-36.4	-41.4	-46.5	-42.2	-47.2	-52.3
240	-28.4	-33.5	-38.6	-31.7	-36.7	-41.8	-36.4	-41.5	-46.6
220	-24.3	-29.4	-34.4	-26.8	-31.9	-37.0	-30.6	-35.7	-40.8
200	-20.0	-25.0	-30.1	-21.8	-26.9	-32.0	-24.8	-29.9	-35.0
180	-15.5	-20.6	-25.7	-16.7	-21.8	-26.9	-19.0	-24.1	-29.1
160	-11.0	-16.0	-21.1	-11.5	-16.6	-21.7	-13.1	-18.2	-23.3

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
3200							128.5		
3400							177.1		
3600							223.7	125.0	
3800				165.6			266.2	173.6	
4000	132.1			221.2			305.4	220.5	121.5
4200	198.7			268.3	161.3		341.9	263.3	170.1
4400	253.1	127.2		309.7	217.5		376.6	302.6	217.3
4600	298.2	194.2		347.0	265.1	157.1		339.4	260.3
4800	337.4	249.6	122.4	382.0	306.8	213.7		374.2	299.9
5000	372.9	295.1	189.6		344.4	261.9			336.8
5200		334.7	246.0		379.5	304.0			371.7
5400		370.4	292.1			341.8			
5600			332.0			377.0			
5800			367.8						

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -100 m/+95 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slush/Standing Water Takeoff

No Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-42	-38	-34	-36	-32	-28	-23	-19	-15
340	-44	-40	-36	-38	-34	-30	-25	-21	-17
320	-45	-41	-37	-40	-36	-32	-27	-23	-19
300	-46	-42	-38	-41	-37	-33	-29	-25	-21
280	-47	-43	-39	-43	-39	-35	-32	-28	-24
260	-47	-43	-39	-44	-40	-36	-35	-31	-27
240	-48	-44	-40	-45	-41	-37	-37	-33	-29
220	-48	-44	-40	-45	-41	-37	-40	-36	-32
200	-48	-44	-40	-46	-42	-38	-41	-37	-33
180	-48	-44	-40	-46	-42	-38	-42	-38	-34
160	-48	-44	-40	-46	-42	-38	-43	-39	-35

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

**Slippery Runway Takeoff
Maximum Reverse Thrust
Weight Adjustments (1000 KG)**

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	0.0	-1.5	-2.9	-21.4	-22.9	-24.3	-38.0	-39.5	-40.9
340	-1.6	-3.1	-4.5	-21.4	-22.8	-24.3	-36.4	-37.9	-39.3
320	-4.0	-5.5	-6.9	-21.3	-22.7	-24.2	-34.9	-36.3	-37.8
300	-5.4	-6.8	-8.3	-21.0	-22.5	-23.9	-33.3	-34.8	-36.2
280	-5.8	-7.3	-8.7	-20.5	-21.9	-23.4	-31.6	-33.1	-34.5
260	-5.8	-7.2	-8.7	-19.2	-20.7	-22.1	-29.1	-30.6	-32.0
240	-5.2	-6.7	-8.1	-17.2	-18.7	-20.1	-25.9	-27.3	-28.8
220	-4.2	-5.7	-7.2	-14.5	-15.9	-17.4	-21.9	-23.3	-24.8
200	-2.8	-4.2	-5.7	-11.0	-12.4	-13.9	-17.1	-18.5	-20.0
180	-0.8	-2.3	-3.7	-6.7	-8.2	-9.7	-11.5	-12.9	-14.4
160	0.0	-0.2	-1.6	-2.2	-3.7	-5.1	-5.6	-7.0	-8.5

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1600	143.2								
1800	210.7	144.9							
2000	277.9	212.3	146.5	121.3					
2200	344.9	279.5	213.9	169.0					
2400	411.7	346.5	281.1	217.0	152.7				
2600		413.3	348.1	266.5	200.4	136.4	140.9		
2800				317.9	249.4	184.0	172.2		
3000				371.1	300.1	232.4	203.7	140.5	
3200					352.7	282.5	236.1	171.8	
3400						334.5	269.6	203.3	140.2
3600						388.1	304.3	235.7	171.4
3800							340.2	269.2	202.9
4000							377.5	303.8	235.3
4200								339.8	268.8
4400								377.0	303.4
4600									339.4
4800									376.6

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -35 m/+30 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -50 m/+45 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -65 m/+60 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
V1 Adjustments (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-6	-4	-2	-18	-16	-14	-33	-31	-29
340	-9	-7	-5	-21	-19	-17	-36	-34	-32
320	-10	-8	-6	-23	-21	-19	-39	-37	-35
300	-12	-10	-8	-25	-23	-21	-41	-39	-37
280	-13	-11	-9	-27	-25	-23	-42	-40	-38
260	-14	-12	-10	-28	-26	-24	-44	-42	-40
240	-14	-12	-10	-29	-27	-25	-45	-43	-41
220	-15	-13	-11	-30	-28	-26	-45	-43	-41
200	-15	-13	-11	-30	-28	-26	-46	-44	-42
180	-16	-14	-12	-30	-28	-26	-46	-44	-42
160	-16	-14	-12	-30	-28	-26	-46	-44	-42

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slippery Runway Takeoff

No Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-6.0	-7.1	-8.2	-33.7	-34.8	-35.9	-54.8	-55.9	-56.9
340	-8.4	-9.5	-10.6	-32.9	-34.0	-35.1	-51.6	-52.7	-53.8
320	-10.2	-11.3	-12.4	-32.1	-33.2	-34.3	-48.9	-50.0	-51.0
300	-11.4	-12.5	-13.6	-31.5	-32.6	-33.6	-46.5	-47.6	-48.7
280	-12.0	-13.1	-14.1	-30.6	-31.7	-32.8	-44.2	-45.3	-46.3
260	-11.9	-13.0	-14.1	-28.8	-29.9	-31.0	-41.1	-42.2	-43.3
240	-11.1	-12.2	-13.3	-26.1	-27.2	-28.3	-37.3	-38.4	-39.5
220	-9.7	-10.8	-11.9	-22.5	-23.5	-24.6	-32.8	-33.9	-35.0
200	-7.6	-8.7	-9.8	-17.9	-19.0	-20.1	-27.5	-28.6	-29.7
180	-4.9	-6.0	-7.1	-12.4	-13.5	-14.6	-21.4	-22.5	-23.6
160	-1.9	-3.0	-4.1	-6.5	-7.6	-8.7	-15.1	-16.2	-17.3

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2000	160.9								
2200	267.5	171.1							
2400	351.0	275.4	181.3						
2600		357.5	283.1						
2800			364.0						
3200				221.8					
3400				316.2	183.1				
3600				385.4	293.6	138.0			
3800					366.8	268.7			
4000						348.1			
4800							121.1		
5000							195.4		
5200							267.3	143.0	
5400							335.7	216.9	
5600								287.7	164.8
5800								355.3	238.1
6000									307.9

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -40 m/+35 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -60 m/+55 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -95 m/+90 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-10	-6	-2	-27	-23	-19	-54	-50	-46
340	-12	-8	-4	-31	-27	-23	-58	-54	-50
320	-14	-10	-6	-34	-30	-26	-62	-58	-54
300	-16	-12	-8	-37	-33	-29	-65	-61	-57
280	-18	-14	-10	-39	-35	-31	-68	-64	-60
260	-19	-15	-11	-41	-37	-33	-71	-67	-63
240	-21	-17	-13	-43	-39	-35	-73	-69	-65
220	-22	-18	-14	-45	-41	-37	-75	-71	-67
200	-23	-19	-15	-48	-44	-40	-77	-73	-69
180	-24	-20	-16	-50	-46	-42	-77	-73	-69
160	-25	-21	-17	-52	-48	-44	-78	-74	-70

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

10% Thrust Reduction

Maximum Reverse Thrust

Weight Adjustment (1000 KG)

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-35.0	-39.9	-44.8	-42.0	-46.9	-51.8	-53.6	-58.5	-63.4
340	-33.2	-38.1	-43.0	-39.5	-44.4	-49.3	-50.1	-55.0	-59.9
320	-31.5	-36.4	-41.3	-37.2	-42.1	-46.9	-46.6	-51.5	-56.4
300	-29.4	-34.3	-39.2	-34.5	-39.4	-44.3	-42.8	-47.7	-52.6
280	-27.1	-32.0	-36.9	-31.5	-36.4	-41.3	-38.7	-43.6	-48.5
260	-24.4	-29.3	-34.2	-28.3	-33.2	-38.1	-34.4	-39.3	-44.2
240	-21.5	-26.4	-31.3	-24.7	-29.6	-34.5	-29.8	-34.7	-39.6
220	-18.3	-23.2	-28.1	-20.9	-25.8	-30.7	-24.8	-29.7	-34.6
200	-14.8	-19.7	-24.6	-16.7	-21.6	-26.5	-19.6	-24.5	-29.4
180	-11.0	-15.9	-20.8	-12.3	-17.2	-22.1	-14.2	-19.1	-24.0
160	-6.9	-11.7	-16.6	-7.6	-12.5	-17.4	-8.4	-13.3	-18.2

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2000				123.0			144.4		
2200	146.8			159.7			181.3		
2400	183.4			196.6	127.0		218.5	148.5	
2600	220.5	150.8		234.2	163.7		256.3	185.4	
2800	258.5	187.4		272.4	200.7	131.0	294.7	222.6	152.6
3000	297.3	224.7	154.8	311.5	238.4	167.8	333.8	260.5	189.4
3200	336.9	262.7	191.5	351.3	276.7	204.8	373.5	299.0	226.8
3400	377.4	301.6	228.8		315.8	242.5		338.1	264.7
3600		341.3	266.9		355.7	281.0		377.9	303.2
3800		381.8	305.9			320.2			342.5
4000			345.8			360.1			382.3
4200			386.3						

1. Enter Weight Adjustment table with slush/standing water depth and TO1 dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -65 m/+60 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff
10% Thrust Reduction
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-24	-22	-20	-20	-18	-16	-11	-9	-7
340	-26	-24	-22	-21	-19	-17	-12	-10	-8
320	-28	-26	-24	-23	-21	-19	-13	-11	-9
300	-29	-27	-25	-25	-23	-21	-15	-13	-11
280	-30	-28	-26	-26	-24	-22	-17	-15	-13
260	-30	-28	-26	-27	-25	-23	-19	-17	-15
240	-30	-28	-26	-27	-25	-23	-21	-19	-17
220	-30	-28	-26	-27	-25	-23	-22	-20	-18
200	-29	-27	-25	-27	-25	-23	-23	-21	-19
180	-28	-26	-24	-27	-25	-23	-23	-21	-19
160	-28	-26	-24	-26	-24	-22	-23	-21	-19

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

10% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 KG)

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-48.6	-53.7	-58.8	-56.8	-61.9	-67.0	-70.5	-75.6	-80.7
340	-45.8	-50.8	-55.9	-53.1	-58.2	-63.3	-65.2	-70.3	-75.3
320	-42.9	-48.0	-53.0	-49.5	-54.6	-59.6	-59.9	-65.0	-70.1
300	-39.8	-44.9	-50.0	-45.6	-50.7	-55.8	-54.6	-59.6	-64.7
280	-36.6	-41.6	-46.7	-41.6	-46.7	-51.8	-49.2	-54.2	-59.3
260	-33.1	-38.2	-43.3	-37.4	-42.5	-47.5	-43.7	-48.8	-53.9
240	-29.4	-34.5	-39.6	-33.0	-38.1	-43.1	-38.2	-43.3	-48.3
220	-25.5	-30.6	-35.7	-28.4	-33.5	-38.6	-32.6	-37.7	-42.7
200	-21.5	-26.5	-31.6	-23.6	-28.7	-33.8	-26.9	-32.0	-37.1
180	-17.2	-22.2	-27.3	-18.7	-23.8	-28.8	-21.2	-26.3	-31.4
160	-12.7	-17.7	-22.8	-13.5	-18.6	-23.7	-15.4	-20.4	-25.5

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
3000							139.9		
3200							194.3		
3400				135.9			245.1	136.0	
3600				202.7			291.9	190.4	
3800	187.8			260.6	131.0		335.8	241.6	132.1
4000	254.6			310.8	198.1		377.7	288.7	186.6
4200	308.8	182.1		356.1	256.8	126.2		332.7	238.0
4400	355.8	250.3			307.4	193.5		374.7	285.4
4600		305.1	176.3		353.0	252.8			329.6
4800		352.6	246.0			304.0			371.7
5000			301.5			349.9			
5200			349.3						

1. Enter Weight Adjustment table with slush/standing water depth and TO1 dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -100 m/+95 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff
10% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-39	-35	-31	-32	-28	-24	-17	-13	-9
340	-41	-37	-33	-34	-30	-26	-19	-15	-11
320	-42	-38	-34	-36	-32	-28	-21	-17	-13
300	-44	-40	-36	-38	-34	-30	-24	-20	-16
280	-44	-40	-36	-39	-35	-31	-27	-23	-19
260	-45	-41	-37	-41	-37	-33	-31	-27	-23
240	-45	-41	-37	-42	-38	-34	-33	-29	-25
220	-45	-41	-37	-42	-38	-34	-36	-32	-28
200	-45	-41	-37	-43	-39	-35	-38	-34	-30
180	-45	-41	-37	-43	-39	-35	-39	-35	-31
160	-46	-42	-38	-44	-40	-36	-40	-36	-32

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
10% Thrust Reduction
Maximum Reverse Thrust
Weight Adjustments (1000 KG)

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	0.0	-1.5	-2.9	-19.0	-20.5	-21.9	-35.7	-37.1	-38.6
340	0.0	-1.5	-2.9	-19.1	-20.6	-22.0	-34.4	-35.8	-37.3
320	-1.5	-2.9	-4.4	-19.4	-20.9	-22.3	-33.2	-34.7	-36.1
300	-3.9	-5.3	-6.8	-19.5	-21.0	-22.4	-32.0	-33.5	-35.0
280	-5.1	-6.6	-8.0	-19.5	-21.0	-22.4	-30.9	-32.4	-33.8
260	-5.5	-6.9	-8.4	-19.1	-20.5	-22.0	-29.4	-30.8	-32.3
240	-5.4	-6.8	-8.3	-17.8	-19.3	-20.7	-27.0	-28.4	-29.9
220	-4.7	-6.2	-7.6	-15.7	-17.2	-18.6	-23.7	-25.2	-26.6
200	-3.6	-5.1	-6.5	-12.8	-14.3	-15.7	-19.6	-21.0	-22.5
180	-2.0	-3.4	-4.9	-9.1	-10.6	-12.1	-14.6	-16.0	-17.5
160	0.0	-1.4	-2.8	-4.7	-6.2	-7.6	-8.8	-10.3	-11.7

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1600	172.9								
1800	243.8	174.6							
2000	314.4	245.5	176.3	147.3					
2200	384.9	316.1	247.2	197.6	130.1				
2400		386.6	317.8	249.2	180.3		130.1		
2600			388.3	302.8	231.3	163.2	163.1		
2800				358.6	284.3	213.7	196.3	129.7	
3000					339.3	265.9	230.4	162.7	
3200					396.1	320.2	265.7	195.9	129.3
3400						376.6	302.3	230.0	162.3
3600							340.5	265.2	195.5
3800							380.0	301.9	229.5
4000								340.0	264.8
4200								379.6	301.4
4400									339.5
4600									379.1

1. Enter Weight Adjustment table with reported braking action and TO1 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -35 m/+30 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -50 m/+45 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -65 m/+60 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
10% Thrust Reduction
Maximum Reverse Thrust
V1 Adjustments (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-7	-5	-3	-18	-16	-14	-31	-29	-27
340	-9	-7	-5	-20	-18	-16	-34	-32	-30
320	-11	-9	-7	-22	-20	-18	-36	-34	-32
300	-12	-10	-8	-24	-22	-20	-38	-36	-34
280	-13	-11	-9	-26	-24	-22	-40	-38	-36
260	-14	-12	-10	-27	-25	-23	-41	-39	-37
240	-14	-12	-10	-27	-25	-23	-42	-40	-38
220	-15	-13	-11	-28	-26	-24	-43	-41	-39
200	-15	-13	-11	-28	-26	-24	-43	-41	-39
180	-16	-14	-12	-29	-27	-25	-43	-41	-39
160	-16	-14	-12	-29	-27	-25	-44	-42	-40

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff

10% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 KG)

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-2.5	-3.5	-4.6	-31.1	-32.2	-33.3	-52.9	-54.0	-55.1
340	-5.1	-6.2	-7.3	-30.5	-31.6	-32.7	-50.0	-51.1	-52.2
320	-7.6	-8.7	-9.8	-30.0	-31.1	-32.2	-47.4	-48.5	-49.6
300	-9.5	-10.6	-11.7	-29.7	-30.7	-31.8	-45.1	-46.2	-47.3
280	-10.7	-11.8	-12.9	-29.3	-30.4	-31.5	-43.3	-44.4	-45.4
260	-11.3	-12.4	-13.5	-28.6	-29.7	-30.8	-41.2	-42.3	-43.4
240	-11.1	-12.2	-13.3	-26.8	-27.9	-29.0	-38.4	-39.4	-40.5
220	-10.3	-11.4	-12.4	-24.0	-25.1	-26.2	-34.6	-35.7	-36.8
200	-8.7	-9.8	-10.9	-20.2	-21.3	-22.4	-30.0	-31.1	-32.2
180	-6.4	-7.5	-8.6	-15.4	-16.5	-17.6	-24.6	-25.7	-26.8
160	-3.5	-4.6	-5.7	-9.6	-10.7	-11.8	-18.3	-19.4	-20.5

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2000	232.8								
2200	329.7	242.2	130.8						
2400		337.0	251.3						
2600			344.3						
3000				230.6					
3200				328.5	190.7				
3400					305.1	141.9			
3600					382.1	279.1			
3800						361.8			
4600							183.2		
4800							262.8	125.4	
5000							338.3	207.1	
5200								285.4	149.5
5400								359.8	230.5
5600									307.7
5800									381.2

1. Enter Weight Adjustment table with reported braking action and TO1 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -40 m/+35 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -60 m/+55 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -95 m/+90 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
10% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-10	-6	-2	-26	-22	-18	-50	-46	-42
340	-12	-8	-4	-29	-25	-21	-54	-50	-46
320	-14	-10	-6	-31	-27	-23	-57	-53	-49
300	-16	-12	-8	-34	-30	-26	-61	-57	-53
280	-17	-13	-9	-36	-32	-28	-64	-60	-56
260	-18	-14	-10	-38	-34	-30	-66	-62	-58
240	-20	-16	-12	-40	-36	-32	-68	-64	-60
220	-21	-17	-13	-42	-38	-34	-70	-66	-62
200	-22	-18	-14	-44	-40	-36	-71	-67	-63
180	-23	-19	-15	-46	-42	-38	-72	-68	-64
160	-24	-20	-16	-48	-44	-40	-73	-69	-65

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

20% Thrust Reduction

Maximum Reverse Thrust

Weight Adjustment (1000 KG)

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-33.8	-38.7	-43.6	-40.8	-45.7	-50.6	-52.6	-57.5	-62.4
340	-31.8	-36.7	-41.6	-38.1	-43.0	-47.9	-48.9	-53.8	-58.7
320	-30.0	-34.9	-39.8	-35.9	-40.8	-45.7	-45.6	-50.5	-55.4
300	-28.6	-33.5	-38.4	-33.8	-38.7	-43.6	-42.5	-47.4	-52.3
280	-26.8	-31.7	-36.6	-31.5	-36.4	-41.3	-39.1	-44.0	-48.9
260	-24.7	-29.6	-34.5	-28.7	-33.6	-38.5	-35.3	-40.2	-45.1
240	-22.2	-27.1	-32.0	-25.7	-30.6	-35.5	-31.2	-36.1	-41.0
220	-19.4	-24.3	-29.2	-22.2	-27.1	-32.0	-26.7	-31.6	-36.5
200	-16.2	-21.1	-26.0	-18.4	-23.3	-28.2	-21.8	-26.7	-31.6
180	-12.6	-17.5	-22.4	-14.3	-19.2	-24.1	-16.7	-21.6	-26.5
160	-8.7	-13.6	-18.5	-9.8	-14.6	-19.5	-11.1	-16.0	-20.9

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1800							131.5		
2000	137.0			149.8			171.4		
2200	176.6			189.8			211.6	135.9	
2400	217.0	141.3		230.6	154.2		252.7	175.8	
2600	258.5	181.0		272.5	194.2		294.7	216.1	140.3
2800	301.3	221.5	145.7	315.5	235.2	158.6	337.8	257.3	180.2
3000	345.3	263.2	185.4	359.7	277.2	198.7	381.9	299.4	220.6
3200	390.5	306.1	226.0		320.3	239.7		342.6	261.9
3400		350.3	267.8		364.6	281.8		386.8	304.1
3600			310.9			325.1			347.4
3800			355.2			369.6			391.7

1. Enter Weight Adjustment table with slush/standing water depth and TO2 dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -65 m/+60 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION**TO2 Slush/Standing Water Takeoff****20% Thrust Reduction****Maximum Reverse Thrust****V1 Adjustment (KIAS)**

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-21	-19	-17	-16	-14	-12	-6	-4	-2
340	-23	-21	-19	-18	-16	-14	-7	-5	-3
320	-25	-23	-21	-20	-18	-16	-9	-7	-5
300	-26	-24	-22	-21	-19	-17	-11	-9	-7
280	-27	-25	-23	-23	-21	-19	-13	-11	-9
260	-27	-25	-23	-24	-22	-20	-15	-13	-11
240	-27	-25	-23	-24	-22	-20	-17	-15	-13
220	-27	-25	-23	-24	-22	-20	-18	-16	-14
200	-26	-24	-22	-24	-22	-20	-19	-17	-15
180	-26	-24	-22	-24	-22	-20	-19	-17	-15
160	-25	-23	-21	-23	-21	-19	-19	-17	-15

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

20% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 KG)

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-48.0	-53.1	-58.1	-56.4	-61.5	-66.6	-70.9	-76.0	-81.1
340	-45.0	-50.1	-55.1	-52.7	-57.7	-62.8	-65.6	-70.7	-75.8
320	-42.2	-47.2	-52.3	-49.1	-54.1	-59.2	-60.4	-65.5	-70.6
300	-39.5	-44.5	-49.6	-45.6	-50.7	-55.7	-55.3	-60.4	-65.5
280	-36.5	-41.6	-46.7	-41.9	-47.0	-52.0	-50.1	-55.2	-60.3
260	-33.4	-38.5	-43.6	-38.0	-43.1	-48.1	-44.9	-50.0	-55.0
240	-30.0	-35.1	-40.2	-33.9	-38.9	-44.0	-39.5	-44.6	-49.7
220	-26.4	-31.5	-36.5	-29.5	-34.6	-39.7	-34.1	-39.2	-44.3
200	-22.5	-27.6	-32.7	-25.0	-30.0	-35.1	-28.6	-33.7	-38.7
180	-18.4	-23.5	-28.6	-20.2	-25.3	-30.4	-23.0	-28.1	-33.1
160	-14.0	-19.1	-24.2	-15.2	-20.2	-25.3	-17.2	-22.3	-27.4

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2800							153.7		
3000							217.1		
3200				178.3			275.0	149.0	
3400	174.6			251.6			328.7	212.7	
3600	257.5			313.2	172.5		379.7	271.0	144.4
3800	322.4	167.6		368.2	246.8			324.9	208.2
4000	379.1	252.3			309.0	166.6		376.1	266.9
4200		318.1	160.7		364.3	242.0			321.2
4400		375.1	247.1			304.8			372.4
4600			313.8			360.5			
4800			371.1						

1. Enter Weight Adjustment table with slush/standing water depth and TO2 dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -100 m/+95 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff
20% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-34	-30	-26	-25	-21	-17	-7	-3	0
340	-36	-32	-28	-28	-24	-20	-10	-6	-2
320	-38	-34	-30	-30	-26	-22	-13	-9	-5
300	-39	-35	-31	-32	-28	-24	-16	-12	-8
280	-40	-36	-32	-34	-30	-26	-20	-16	-12
260	-41	-37	-33	-36	-32	-28	-24	-20	-16
240	-41	-37	-33	-37	-33	-29	-27	-23	-19
220	-41	-37	-33	-38	-34	-30	-30	-26	-22
200	-41	-37	-33	-39	-35	-31	-32	-28	-24
180	-41	-37	-33	-39	-35	-31	-34	-30	-26
160	-41	-37	-33	-39	-35	-31	-34	-30	-26

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff

20% Thrust Reduction

Maximum Reverse Thrust

Weight Adjustments (1000 KG)

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	0.0	-1.5	-2.9	-17.6	-19.1	-20.5	-34.9	-36.3	-37.8
340	0.0	-1.5	-2.9	-17.6	-19.1	-20.6	-33.3	-34.7	-36.2
320	0.0	-1.5	-2.9	-17.8	-19.2	-20.7	-32.0	-33.4	-34.9
300	-1.5	-2.9	-4.4	-18.1	-19.5	-21.0	-30.9	-32.4	-33.8
280	-3.8	-5.2	-6.7	-18.3	-19.7	-21.2	-29.9	-31.3	-32.8
260	-4.9	-6.3	-7.8	-18.3	-19.7	-21.2	-28.8	-30.3	-31.7
240	-5.2	-6.6	-8.1	-17.7	-19.2	-20.6	-27.2	-28.6	-30.1
220	-4.9	-6.4	-7.8	-16.3	-17.7	-19.2	-24.6	-26.0	-27.5
200	-4.1	-5.6	-7.1	-14.0	-15.4	-16.9	-21.1	-22.5	-24.0
180	-2.8	-4.3	-5.7	-10.8	-12.2	-13.7	-16.7	-18.1	-19.6
160	-1.0	-2.4	-3.9	-6.7	-8.2	-9.6	-11.3	-12.7	-14.2

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1400	130.8								
1600	205.8	132.6							
1800	280.6	207.6	134.4	123.3					
2000	355.4	282.4	209.3	176.5					
2200		357.2	284.2	230.5	158.3				
2400			359.0	286.8	211.8	140.1	153.4		
2600				345.5	267.3	193.3	188.6		
2800					325.1	248.1	224.6	153.0	
3000					385.4	305.1	262.1	188.2	
3200						364.6	301.2	224.2	152.5
3400							342.0	261.7	187.7
3600							384.4	300.7	223.8
3800								341.5	261.2
4000								383.9	300.2
4200									341.0
4400									383.4

1. Enter Weight Adjustment table with reported braking action and TO2 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -35 m/+30 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -50 m/+45 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -65 m/+60 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

**TO2 Slippery Runway Takeoff
20% Thrust Reduction
Maximum Reverse Thrust
V1 Adjustments (KIAS)**

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-7	-5	-3	-16	-14	-12	-28	-26	-24
340	-9	-7	-5	-19	-17	-15	-31	-29	-27
320	-10	-8	-6	-20	-18	-16	-33	-31	-29
300	-11	-9	-7	-22	-20	-18	-35	-33	-31
280	-12	-10	-8	-23	-21	-19	-37	-35	-33
260	-13	-11	-9	-24	-22	-20	-38	-36	-34
240	-13	-11	-9	-25	-23	-21	-39	-37	-35
220	-14	-12	-10	-25	-23	-21	-39	-37	-35
200	-14	-12	-10	-26	-24	-22	-40	-38	-36
180	-14	-12	-10	-26	-24	-22	-40	-38	-36
160	-15	-13	-11	-26	-24	-22	-40	-38	-36

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff

20% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 KG)

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	0.0	-0.4	-1.5	-29.9	-30.9	-32.0	-52.6	-53.7	-54.8
340	-2.0	-3.0	-4.1	-29.0	-30.1	-31.2	-49.6	-50.7	-51.8
320	-4.6	-5.7	-6.8	-28.4	-29.5	-30.6	-46.8	-47.8	-48.9
300	-7.1	-8.2	-9.3	-28.0	-29.1	-30.2	-44.2	-45.3	-46.4
280	-9.0	-10.1	-11.2	-27.7	-28.8	-29.9	-42.1	-43.2	-44.3
260	-10.2	-11.3	-12.4	-27.4	-28.5	-29.6	-40.3	-41.4	-42.5
240	-10.6	-11.7	-12.8	-26.6	-27.7	-28.7	-38.2	-39.3	-40.4
220	-10.3	-11.4	-12.5	-24.6	-25.7	-26.7	-35.2	-36.3	-37.4
200	-9.2	-10.3	-11.4	-21.5	-22.6	-23.7	-31.3	-32.3	-33.4
180	-7.4	-8.5	-9.6	-17.3	-18.4	-19.5	-26.4	-27.5	-28.6
160	-4.8	-5.9	-7.0	-12.0	-13.1	-14.2	-20.5	-21.6	-22.7

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1800	185.5								
2000	302.0	197.2							
2200	394.2	310.5	208.5						
2400			318.9						
2800				238.7					
3000				341.3	196.9				
3200					316.7	144.0			
3400					399.1	289.6			
3600						376.8			
4200							164.7		
4400							253.5		
4600							337.5	191.3	
4800								278.7	127.5
5000								361.3	217.6
5200									303.5
5400									385.1

1. Enter Weight Adjustment table with reported braking action and TO2 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -40 m/+35 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -60 m/+55 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -95 m/+90 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
20% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-9	-5	-1	-23	-19	-15	-45	-41	-37
340	-11	-7	-3	-26	-22	-18	-49	-45	-41
320	-13	-9	-5	-28	-24	-20	-52	-48	-44
300	-14	-10	-6	-30	-26	-22	-55	-51	-47
280	-16	-12	-8	-32	-28	-24	-58	-54	-50
260	-17	-13	-9	-34	-30	-26	-60	-56	-52
240	-18	-14	-10	-36	-32	-28	-62	-58	-54
220	-18	-14	-10	-38	-34	-30	-64	-60	-56
200	-19	-15	-11	-39	-35	-31	-65	-61	-57
180	-20	-16	-12	-41	-37	-33	-66	-62	-58
160	-21	-17	-13	-43	-39	-35	-66	-62	-58

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

Minimum Control Speeds

V1(MCG)

Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
60	140	125	121	119	117		
50	122	128	125	119	117	115	110
40	104	136	133	127	122	116	110
30	86	138	137	133	127	122	115
20	68	138	138	134	130	126	119
-60	-76	140	139	135	131	127	121

TO1 V1(MCG)

10% Thrust Reduction

TEMP		PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
60	140	118	115	112	111		
50	122	122	118	113	111	109	105
40	104	129	126	120	115	110	105
30	86	130	130	126	120	115	109
20	68	130	130	127	123	119	113
-60	-76	132	132	128	124	120	115

TO2 V1(MCG)

20% Thrust Reduction

TEMP		PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
60	140	112	108	106	104		
50	122	115	112	106	104	103	99
40	104	121	119	113	108	104	99
30	86	122	122	118	113	108	102
20	68	123	122	119	116	112	106
-60	-76	125	124	121	117	113	108

Go-around %N1**Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off**

REPORTED OAT		TAT	AIRPORT PRESSURE ALTITUDE (1000 FT)													
°C	°F	°C	-2	-1	0	1	2	3	4	5	6	7	8	9	10	
66	150	70	93.2	93.3	93.6	93.4	93.3	93.3	93.3	93.4	93.3	92.6	91.5	90.5	89.6	
56	133	60	95.9	96.1	96.4	96.2	96.1	96.1	96.1	96.2	96.1	95.4	94.3	93.4	92.5	
51	124	55	97.2	97.6	97.9	97.7	97.5	97.5	97.5	97.5	97.4	96.7	95.7	94.7	93.9	
46	115	50	98.5	98.9	99.3	99.2	98.9	98.8	98.8	98.8	98.7	98.0	97.0	96.1	95.2	
41	106	45	99.6	100.1	100.6	100.5	100.2	100.2	100.1	100.2	100.0	99.3	98.3	97.3	96.5	
36	97	40	100.4	101.6	102.4	102.3	101.9	101.8	101.7	101.7	101.3	100.5	99.5	98.6	97.8	
31	88	35	99.6	101.2	103.2	104.4	103.9	103.7	103.6	103.5	102.7	101.7	100.6	99.7	98.9	
26	79	30	98.8	100.4	102.3	103.8	105.1	105.9	105.9	106.1	105.0	103.4	101.9	100.8	100.0	
21	70	25	97.9	99.5	101.5	102.9	104.2	105.2	106.3	107.2	106.8	105.7	104.0	102.3	101.3	
16	61	20	97.1	98.7	100.6	102.0	103.3	104.3	105.4	106.5	106.8	106.3	105.2	104.2	103.3	
11	53	15	96.3	97.9	99.8	101.2	102.4	103.4	104.5	105.6	105.9	105.5	104.9	104.4	104.0	
7	44	10	95.4	97.0	98.9	100.3	101.5	102.5	103.6	104.6	105.0	104.6	104.0	103.5	103.4	
2	35	5	94.6	96.1	98.0	99.4	100.6	101.6	102.7	103.7	104.1	103.7	103.1	102.5	102.5	
-3	26	0	93.7	95.3	97.1	98.5	99.7	100.7	101.7	102.8	103.1	102.7	102.1	101.6	101.6	
-13	8	-10	92.0	93.5	95.3	96.7	97.9	98.8	99.8	100.9	101.2	100.8	100.3	99.7	99.7	
-23	-10	-20	90.2	91.7	93.5	94.8	96.0	96.9	97.9	98.9	99.3	98.9	98.3	97.8	97.8	
-33	-27	-30	88.4	89.9	91.7	92.9	94.1	95.0	96.0	97.0	97.3	96.9	96.4	95.9	95.8	
-43	-45	-40	86.6	88.0	89.7	91.0	92.1	93.0	94.0	95.0	95.3	94.9	94.4	93.9	93.9	
-53	-63	-50	84.7	86.1	87.8	89.0	90.1	91.0	91.9	92.9	93.2	92.9	92.3	91.8	91.8	

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)												
	-2	-1	0	1	2	3	4	5	6	7	8	9	10
PACKS OFF	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
1 PACK ON	-0.2	-0.2	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3	-0.3
WING ANTI-ICE ON	-0.2	-0.3	-0.4	-0.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4

Max Climb %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)									
	0	5	10	15	20	25	30	35	40	43
	310	310	310	310	310	310	310	.84	.84	.84
60	88.3	88.1	90.3	91.0	93.1	96.7	99.6	101.7	101.8	101.3
50	90.6	90.4	90.2	89.6	91.7	95.3	98.0	100.1	100.2	99.7
40	92.5	92.4	92.4	92.2	90.5	93.8	96.5	98.6	98.7	98.2
30	91.6	94.1	94.2	94.0	93.1	94.2	95.2	97.0	97.1	96.6
20	90.1	92.5	95.1	95.8	95.9	95.9	96.9	95.9	95.5	95.0
15	89.3	91.7	94.3	96.9	96.9	96.9	97.8	96.6	95.8	95.4
10	88.6	90.9	93.5	96.1	98.4	98.1	98.8	97.2	96.5	96.0
5	87.8	90.1	92.7	95.2	98.1	99.6	100.1	98.1	97.2	96.8
0	87.0	89.3	91.8	94.4	97.3	99.9	101.5	99.3	98.1	97.6
-5	86.2	88.5	91.0	93.5	96.4	99.0	101.9	100.5	99.5	98.8
-10	85.4	87.7	90.1	92.6	95.5	98.1	100.9	101.3	100.5	100.0
-15	84.6	86.8	89.3	91.7	94.5	97.1	100.0	101.0	100.9	100.5
-20	83.7	86.0	88.4	90.8	93.6	96.2	99.0	100.1	99.9	99.5
-25	82.9	85.1	87.5	89.9	92.7	95.2	98.0	99.1	98.9	98.5
-30	82.1	84.3	86.7	89.0	91.8	94.3	97.0	98.1	97.9	97.5
-35	81.2	83.4	85.8	88.1	90.8	93.3	96.0	97.0	96.9	96.5
-40	80.4	82.5	84.9	87.2	89.8	92.3	95.0	96.0	95.9	95.5

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)									
	0	5	10	15	20	25	30	35	40	43
2 PACKS ON - 1 BLEED SOURCE	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4	-0.4	-0.5
1 PACK ON - 1 OR 2 BLEED SOURCES	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4	-0.4	-0.5
ENGINE ANTI-ICE ON	-0.3	-0.5	-0.4	-0.3	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
ENGINE AND WING ANTI-ICE ON*	-0.6	-0.8	-0.7	-0.5	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4
ENGINE AND WING ANTI-ICE ON**	-1.1	-0.9	-0.9	-0.6	-0.3	-0.4	-0.5	-0.5	-0.6	-0.6

*Packs on or packs off with 2 bleed sources.

**Packs off with 1 bleed source.

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb**Flaps Up, Set Max Climb Thrust**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		150	200	250	300	350
40000 (.82M)	PITCH ATT	5.0	4.5			
	V/S (FT/MIN)	2500	1500			
30000 (280 KIAS)	PITCH ATT	6.5	5.5	5.5	5.0	4.5
	V/S (FT/MIN)	3700	2600	1800	1300	900
20000 (270 KIAS)	PITCH ATT	9.5	8.5	8.0	7.5	7.5
	V/S (FT/MIN)	5000	3600	2700	2000	1400
10000 (270 KIAS)	PITCH ATT	14.0	11.5	10.0	9.5	9.5
	V/S (FT/MIN)	6700	4900	3700	2900	2200
SEA LEVEL (270 KIAS)	PITCH ATT	17.5	14.5	12.5	11.5	11.0
	V/S (FT/MIN)	7800	5700	4400	3500	2800

Cruise**Flaps Up, %N1 for Level Flight**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		150	200	250	300	350
40000 (.82M)	PITCH ATT	2.0	3.0			
	%N1	78.6	83.2			
35000 (.82M)	PITCH ATT	1.5	2.0	3.0	3.5	
	%N1	76.5	78.9	82.8	88.0	
30000 (280 KIAS)	PITCH ATT	1.5	2.5	3.0	3.5	3.5
	%N1	72.6	74.7	78.1	82.4	87.3
25000 (280 KIAS)	PITCH ATT	1.5	2.5	3.5	4.0	4.0
	%N1	68.6	70.7	73.8	77.7	82.3
20000 (270 KIAS)	PITCH ATT	2.0	2.5	3.5	4.5	5.5
	%N1	63.4	65.8	69.0	72.8	77.4
15000 (270 KIAS)	PITCH ATT	1.5	2.5	3.5	4.5	5.5
	%N1	59.6	61.8	65.0	68.2	72.5

Descent**Flaps Up, Set Idle Thrust**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		150	200	250	300	350
40000 (.82M)	PITCH ATT	-1.5	0.0			
	V/S (FT/MIN)	-2900	-2600			
30000 (280 KIAS)	PITCH ATT	-1.5	-0.5	0.5	1.0	0.5
	V/S (FT/MIN)	-2500	-2000	-1900	-1900	-2400
20000 (270 KIAS)	PITCH ATT	-1.0	0.5	1.5	2.5	3.0
	V/S (FT/MIN)	-1900	-1600	-1500	-1400	-1400
10000 (270 KIAS)	PITCH ATT	-1.5	0.0	1.0	2.0	3.0
	V/S (FT/MIN)	-1700	-1400	-1300	-1300	-1300
SEA LEVEL (270 KIAS)	PITCH ATT	-2.0	-0.5	1.0	2.0	3.0
	V/S (FT/MIN)	-1500	-1300	-1200	-1200	-1200

In shaded areas, data reflects the minimum speed limitation of 15 knots above minimum maneuvering speed.

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Holding

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		150	200	250	300	350
10000	PITCH ATT	3.0	4.5	5.5	6.0	6.0
	%N1	50.2	54.4	59.1	63.9	68.2
	KIAS	216	216	226	244	262
5000	PITCH ATT	3.0	4.5	5.5	6.0	6.0
	%N1	46.6	50.9	55.4	59.7	64.2
	KIAS	216	216	226	244	262

Terminal Area (5000 FT)

%N1 for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		150	200	250	300	350
FLAPS UP GEAR UP (VREF 30 + 80)	PITCH ATT	3.5	5.0	6.0	6.5	6.5
	%N1	47.7	52.3	57.2	61.9	66.4
	KIAS	217	217	225	243	263
FLAPS 1 GEAR UP (VREF 30 + 60)	PITCH ATT	5.0	6.5	8.0	8.0	8.0
	%N1	48.5	53.4	58.8	63.9	68.2
	KIAS	197	197	205	223	243
FLAPS 5 GEAR UP (VREF 30 + 40)	PITCH ATT	3.5	5.5	7.0	7.0	6.5
	%N1	48.8	54.0	59.7	64.7	69.0
	KIAS	177	177	185	203	223
FLAPS 15 GEAR UP (VREF 30 + 20)	PITCH ATT	3.5	6.5	8.0	7.5	7.0
	%N1	49.0	55.2	61.9	66.8	71.2
	KIAS	157	157	165	183	203
FLAPS 20 GEAR DOWN (VREF 30 + 20)	PITCH ATT	2.0	4.5	6.5	6.0	5.5
	%N1	56.2	61.4	67.3	73.1	78.1
	KIAS	157	157	165	183	203

Final Approach (1500 FT)

Gear Down, %N1 for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		150	200	250	300	350
FLAPS 20 (VREF 20 + 10)	PITCH ATT	0.0	2.0	2.0	2.5	2.5
	%N1	36.8	40.7	45.1	49.3	52.6
	KIAS	147	155	172	187	201
FLAPS 25 (VREF 25 + 10)	PITCH ATT	1.0	2.0	2.0	2.5	2.5
	%N1	51.5	49.8	54.7	59.2	63.3
	KIAS	147	147	163	178	191
FLAPS 30 (VREF 30 + 10)	PITCH ATT	0.0	1.0	2.0	1.5	
	%N1	56.9	55.6	60.2	65.3	
	KIAS	147	147	155	172	

Performance Inflight
All Engine

Chapter PI
Section 31

Long Range Cruise Maximum Operating Altitude

Max Climb Thrust

ISA + 10°C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30(39°)	1.40(44°)	1.50(48°)
360	27300	5	30400	28800	27200
350	27900	4	31000	29400	27800
340	28500	3	31700	30000	28500
330	29200	1	32200	30500	29000
320	29900	0	32700	31000	29500
310	30600	-2	33200	31600	30000
300	31300	-4	33700	32100	30600
290	32000	-5	34300	32700	31200
280	32800	-7	34900	33300	31800
270	33600	-9	35500	33900	32400
260	34400	-11	36100	34500	33100
250	35200	-12	36800	35200	33800
240	36000	-14	37500	35900	34500
230	36900	-15	38200	36600	35200
220	37800	-15	39000	37400	36000
210	38800	-15	39800	38200	36800
200	39800	-15	40600	39000	37700
190	40900	-15	41500	39900	38600
180	42000	-15	42500	40900	39600
170	43100	-15	43100	42100	40800
160	43100	-15	43100	43100	42000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27300	11	30400	28800	27200
350	27900	10	31000	29400	27800
340	28500	8	31700	30000	28500
330	29200	7	32200	30500	29000
320	29900	5	32700	31000	29500
310	30600	4	33200	31600	30000
300	31300	2	33700	32100	30600
290	32000	0	34300	32700	31200
280	32800	-1	34900	33300	31800
270	33600	-3	35500	33900	32400
260	34400	-5	36100	34500	33100
250	35200	-7	36800	35200	33800
240	36000	-9	37500	35900	34500
230	36900	-9	38200	36600	35200
220	37800	-9	39000	37400	36000
210	38800	-9	39800	38200	36800
200	39800	-9	40600	39000	37700
190	40900	-9	41500	39900	38600
180	42000	-9	42500	40900	39600
170	43100	-9	43100	42100	40800
160	43100	-9	43100	43100	42000

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27300	17	30400	28800	27200
350	27900	15	31000	29400	27800
340	28500	14	31700	30000	28500
330	29200	12	32200	30500	29000
320	29900	11	32700	31000	29500
310	30600	9	33200	31600	30000
300	31300	8	33700	32100	30600
290	32000	6	34300	32700	31200
280	32800	4	34900	33300	31800
270	33600	3	35500	33900	32400
260	34400	1	36100	34500	33100
250	35200	-1	36800	35200	33800
240	36000	-3	37500	35900	34500
230	36900	-3	38200	36600	35200
220	37800	-3	39000	37400	36000
210	38800	-3	39800	38200	36800
200	39800	-3	40600	39000	37700
190	40900	-3	41500	39900	38600
180	42000	-3	42500	40900	39600
170	43100	-3	43100	42100	40800
160	43100	-3	43100	43100	42000

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		25	27	29	31	33	35	37	39	41	43
360	%N1	84.0	86.0	87.6	90.1						
	MACH	.819	.840	.837	.830						
	KIAS	346	342	326	310						
	FF/ENG	5139	5211	5162	5303						
340	%N1	83.0	84.7	86.1	88.1						
	MACH	.819	.839	.840	.835						
	KIAS	346	341	328	312						
	FF/ENG	4943	4959	4875	4910						
320	%N1	81.9	83.1	84.6	86.0	88.3					
	MACH	.818	.833	.840	.839	.833					
	KIAS	346	339	327	313	297					
	FF/ENG	4735	4662	4585	4523	4633					
300	%N1	80.2	81.8	82.9	84.5	86.1					
	MACH	.800	.823	.836	.840	.837					
	KIAS	337	334	326	314	299					
	FF/ENG	4416	4391	4316	4248	4232					
280	%N1	78.4	80.1	81.6	82.9	84.4	86.2				
	MACH	.775	.806	.827	.838	.840	.836				
	KIAS	326	326	322	313	300	285				
	FF/ENG	4088	4112	4069	4004	3948	3972				
260	%N1	76.6	78.3	80.0	81.3	82.8	84.2	86.6			
	MACH	.746	.780	.810	.830	.839	.839	.834			
	KIAS	313	315	315	309	300	287	272			
	FF/ENG	3751	3796	3803	3758	3703	3653	3726			
240	%N1	74.7	76.3	78.0	79.7	81.0	82.5	84.3			
	MACH	.720	.749	.783	.813	.831	.839	.839			
	KIAS	302	302	303	303	297	287	274			
	FF/ENG	3448	3464	3501	3503	3460	3406	3378			
220	%N1	73.1	74.2	75.8	77.6	79.3	80.6	82.5	84.7		
	MACH	.701	.721	.750	.785	.815	.832	.840	.838		
	KIAS	293	289	289	291	290	284	274	261		
	FF/ENG	3203	3158	3175	3207	3211	3165	3130	3132		
200	%N1	71.1	72.5	73.6	75.2	77.0	78.8	80.4	82.7	84.9	
	MACH	.680	.700	.719	.748	.784	.814	.832	.840	.838	
	KIAS	284	280	277	276	278	277	271	262	249	
	FF/ENG	2958	2915	2872	2886	2917	2918	2888	2878	2879	
180	%N1	68.6	70.2	71.7	72.8	74.4	76.2	78.4	80.4	82.7	84.8
	MACH	.648	.675	.697	.715	.744	.780	.812	.831	.839	.839
	KIAS	270	270	267	263	263	264	264	259	250	238
	FF/ENG	2673	2665	2631	2592	2599	2622	2636	2634	2624	2609
160	%N1	65.8	67.4	69.1	70.7	71.9	73.3	75.5	78.1	80.2	82.5
	MACH	.612	.639	.667	.691	.710	.735	.772	.806	.828	.838
	KIAS	254	254	255	253	250	248	249	250	246	238
	FF/ENG	2392	2386	2375	2356	2321	2308	2335	2372	2379	2356

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitude
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
282	261	242	226	213	200	191	182	174	167	160
559	519	482	451	424	400	382	366	351	337	325
837	777	723	677	637	600	574	550	528	508	489
1115	1035	964	902	849	800	766	734	705	678	653
1395	1295	1206	1129	1061	1000	957	918	881	848	817
1675	1555	1447	1354	1273	1200	1149	1101	1057	1017	980
1956	1815	1689	1581	1486	1400	1340	1285	1234	1187	1144
2237	2075	1931	1807	1698	1600	1532	1469	1410	1356	1307
2520	2338	2174	2034	1911	1800	1723	1652	1586	1525	1470
2803	2599	2417	2260	2124	2000	1915	1835	1762	1695	1633

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	3.8	0:38	3.3	0:37	2.8	0:35	2.5	0:35	2.2	0:34
400	7.9	1:11	7.2	1:09	6.3	1:04	5.7	1:02	5.3	1:00
600	11.9	1:45	11.0	1:40	9.8	1:33	9.0	1:30	8.4	1:26
800	15.9	2:19	14.8	2:13	13.2	2:02	12.2	1:58	11.5	1:52
1000	19.9	2:53	18.6	2:45	16.6	2:31	15.4	2:26	14.5	2:19
1200	23.8	3:27	22.3	3:17	20.0	3:01	18.6	2:54	17.5	2:45
1400	27.8	4:02	26.0	3:50	23.4	3:31	21.8	3:23	20.5	3:12
1600	31.6	4:37	29.7	4:23	26.8	4:01	24.9	3:51	23.5	3:39
1800	35.5	5:12	33.3	4:56	30.1	4:31	28.1	4:19	26.5	4:06
2000	39.3	5:47	36.9	5:30	33.4	5:01	31.2	4:48	29.4	4:33

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	150	200	250	300	350
5	-0.7	-0.4	0.0	0.4	1.1
10	-1.6	-0.8	0.0	1.1	2.5
15	-2.5	-1.3	0.0	1.7	3.9
20	-3.3	-1.7	0.0	2.3	5.2
25	-4.1	-2.2	0.0	2.9	6.5
30	-4.9	-2.6	0.0	3.6	7.8
35	-5.7	-3.1	0.0	4.2	9.0
40	-6.4	-3.5	0.0	4.8	10.2

Long Range Cruise Enroute Fuel and Time - High Altitude
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
649	613	580	551	524	500	479	459	441	424	409
1286	1217	1154	1098	1047	1000	959	921	886	853	823
1926	1824	1730	1646	1570	1500	1439	1383	1330	1282	1237
2569	2432	2307	2195	2094	2000	1920	1845	1775	1710	1651
3215	3043	2886	2745	2617	2500	2400	2306	2219	2139	2065
3864	3656	3466	3296	3142	3000	2880	2768	2664	2568	2479
4516	4271	4047	3847	3666	3500	3360	3229	3108	2996	2893
5170	4888	4630	4400	4192	4000	3840	3691	3552	3424	3306
5826	5506	5214	4953	4717	4500	4320	4152	3996	3852	3719
6485	6126	5798	5506	5242	5000	4800	4613	4440	4279	4132
7146	6748	6384	6061	5768	5500	5280	5074	4883	4706	4545
7809	7371	6972	6616	6295	6000	5759	5534	5326	5133	4956
8474	7996	7559	7171	6821	6500	6238	5994	5768	5558	5367
9144	8624	8149	7728	7348	7000	6717	6454	6209	5983	5776
9818	9255	8741	8286	7876	7500	7196	6912	6649	6406	6184
10496	9889	9335	8845	8404	8000	7674	7371	7089	6829	6591
11179	10526	9932	9406	8933	8500	8153	7829	7528	7251	6997
11866	11167	10530	9968	9462	9000	8631	8286	7966	7671	7401
12559	11811	11131	10531	9993	9500	9108	8742	8403	8090	7804
13256	12459	11735	11096	10523	10000	9585	9198	8839	8508	8206

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
500	6.9	1:10	6.7	1:10	6.5	1:10	6.4	1:10	6.4	1:11
1000	14.3	2:17	13.8	2:13	13.5	2:12	13.2	2:12	13.2	2:13
1500	21.6	3:23	21.0	3:17	20.4	3:15	20.1	3:14	20.0	3:15
2000	29.0	4:29	28.2	4:21	27.4	4:17	26.9	4:17	26.8	4:18
2500	36.0	5:37	35.1	5:27	34.2	5:21	33.5	5:19	33.2	5:20
3000	43.1	6:46	42.0	6:33	40.9	6:25	40.0	6:22	39.7	6:22
3500	49.9	7:56	48.6	7:41	47.4	7:30	46.3	7:25	45.8	7:25
4000	56.7	9:06	55.2	8:49	53.8	8:35	52.7	8:29	52.0	8:27
4500	63.2	10:18	61.6	9:59	60.1	9:42	58.7	9:34	57.9	9:31
5000	69.7	11:30	68.0	11:09	66.3	10:50	64.8	10:38	63.9	10:34
5500	76.0	12:44	74.1	12:21	72.3	11:59	70.7	11:45	69.6	11:38
6000	82.3	13:57	80.2	13:32	78.3	13:09	76.5	12:52	75.3	12:42
6500	88.4	15:13	86.1	14:46	84.1	14:21	82.1	14:01	80.7	13:48
7000	94.5	16:28	92.0	15:59	89.8	15:32	87.8	15:10	86.2	14:54
7500	100.4	17:46	97.7	17:14	95.4	16:46	93.2	16:21	91.5	16:02
8000	106.2	19:05	103.4	18:30	100.9	17:59	98.6	17:32	96.8	17:10
8500	112.0	20:26	109.0	19:47	106.3	19:14	103.8	18:45	101.9	18:20
9000	117.7	21:48	114.5	21:05	111.7	20:29	109.0	19:58	106.9	19:30
9500	123.3	23:12	119.9	22:26	116.9	21:46	114.1	21:13	111.8	20:43
10000	129.0	24:37	125.3	23:47	122.0	23:03	119.1	22:28	116.7	21:55

**Long Range Cruise Enroute Fuel and Time - High Altitude
Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	150	200	250	300	350
10	-2.3	-1.2	0.0	3.2	13.1
20	-4.4	-2.4	0.0	5.4	18.3
30	-6.5	-3.6	0.0	7.4	23.1
40	-8.6	-4.8	0.0	9.3	27.5
50	-10.8	-5.9	0.0	11.1	31.4
60	-13.0	-7.0	0.0	12.7	35.0
70	-15.2	-8.1	0.0	14.2	38.1
80	-17.5	-9.2	0.0	15.6	40.9
90	-19.8	-10.3	0.0	16.8	43.2
100	-22.1	-11.3	0.0	18.0	45.1
110	-24.4	-12.3	0.0	19.0	46.6
120	-26.8	-13.3	0.0	19.8	47.7
130	-29.2	-14.3	0.0	20.6	48.4

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)										
	360	340	320	300	280	260	240	220	200	180	160
43							120	55	17	1	3
41						105	50	17	2	1	12
39					87	43	15	2	1	10	25
37			119	68	33	11	1	1	9	22	40
35		89	50	24	8	1	1	9	21	36	54
33	64	35	15	4	0	2	9	21	35	50	67
31	22	9	2	0	4	11	21	34	49	64	79
29	4	0	1	5	13	23	35	48	62	76	89
27	0	3	8	16	25	36	48	61	74	86	97
25	5	11	19	28	38	50	61	73	84	94	104

The above wind factor table is for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. Read wind factors for present and new altitudes from table.
2. Determine difference (new altitude wind factor minus present altitude wind factor);
This difference may be negative or positive.
3. Break-even wind at new altitude is present altitude wind plus difference from step 2.

Descent at .84M/310/250

PRESSURE ALTITUDE (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	96	103	110	117	123	128	133	139	145	150
TIME (MINUTES)	20	21	22	23	24	24	25	26	26	27

**Holding
Flaps Up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
360	%N1	62.0	64.9	69.0	73.3	78.3	83.1	88.2			
	KIAS	264	264	265	269	308	312	310			
	FF/ENG	4660	4620	4570	4590	4840	5020	5300			
340	%N1	60.5	63.4	67.5	71.7	76.7	81.6	86.4			
	KIAS	260	260	260	260	299	302	307			
	FF/ENG	4410	4360	4310	4310	4540	4680	4890			
320	%N1	58.8	61.5	65.7	69.8	74.9	79.6	84.4	91.3		
	KIAS	253	253	253	253	289	293	297	278		
	FF/ENG	4130	4080	4030	4020	4210	4320	4480	4980		
300	%N1	57.2	59.7	63.9	67.9	72.6	77.6	82.3	88.0		
	KIAS	244	244	244	244	259	283	287	278		
	FF/ENG	3860	3810	3760	3740	3800	3990	4130	4430		
280	%N1	55.6	58.0	62.1	66.1	70.7	75.7	80.5	85.6		
	KIAS	238	238	238	238	238	272	276	278		
	FF/ENG	3630	3570	3510	3480	3500	3690	3810	4030		
260	%N1	53.9	56.3	60.1	64.3	68.6	73.7	78.5	83.5	93.7	
	KIAS	229	229	229	229	229	262	265	269	247	
	FF/ENG	3390	3330	3270	3230	3240	3400	3500	3630	4260	
240	%N1	52.2	54.5	58.2	62.3	66.5	71.1	76.2	81.2	88.6	
	KIAS	223	223	223	223	223	228	254	258	247	
	FF/ENG	3180	3110	3030	2990	2990	3010	3190	3290	3640	
220	%N1	50.4	52.7	56.2	60.1	64.3	68.7	73.9	78.9	85.6	92.1
	KIAS	217	217	217	217	217	217	242	246	247	231
	FF/ENG	2970	2890	2800	2760	2740	2740	2890	2980	3220	3530
200	%N1	48.4	50.9	54.4	58.0	62.2	66.3	71.3	76.3	82.8	87.4
	KIAS	217	217	217	217	217	217	226	233	237	231
	FF/ENG	2790	2710	2610	2570	2530	2520	2570	2670	2830	3010
180	%N1	46.6	49.1	52.7	56.2	60.1	64.3	68.7	73.4	79.9	84.1
	KIAS	217	217	217	217	217	217	217	220	223	226
	FF/ENG	2630	2550	2450	2400	2360	2380	2320	2370	2500	2610
160	%N1	45.1	47.4	51.0	54.5	58.2	62.3	66.5	71.0	77.1	81.1
	KIAS	217	217	217	217	217	217	217	217	217	217
	FF/ENG	2560	2470	2370	2300	2250	2220	2170	2160	2230	2280

This table includes 5% additional fuel for holding in a racetrack pattern.

**Holding
Flaps 1**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
360	%N1	64.8	67.6	72.3	76.7	81.7
	KIAS	244	244	244	244	244
	FF/ENG	5150	5130	5110	5150	5270
340	%N1	63.2	66.0	70.3	74.9	79.9
	KIAS	240	240	240	240	240
	FF/ENG	4840	4810	4790	4810	4920
320	%N1	61.5	64.4	68.5	73.1	78.0
	KIAS	233	233	233	233	233
	FF/ENG	4540	4510	4480	4490	4580
300	%N1	59.7	62.6	66.6	71.3	76.1
	KIAS	224	224	224	224	224
	FF/ENG	4250	4220	4190	4190	4260
280	%N1	57.9	60.6	64.7	69.1	74.0
	KIAS	218	218	218	218	218
	FF/ENG	3970	3930	3890	3880	3930
260	%N1	56.1	58.6	62.8	66.9	71.8
	KIAS	209	209	209	209	209
	FF/ENG	3700	3650	3600	3600	3620
240	%N1	54.2	56.6	60.6	64.6	69.4
	KIAS	203	203	203	203	203
	FF/ENG	3430	3370	3310	3300	3310
220	%N1	52.1	54.5	58.2	62.3	66.7
	KIAS	197	197	197	197	197
	FF/ENG	3170	3100	3030	3010	3010
200	%N1	50.1	52.3	55.9	59.8	64.0
	KIAS	197	197	197	197	197
	FF/ENG	2940	2860	2770	2730	2720
180	%N1	47.9	50.3	53.8	57.4	61.6
	KIAS	197	197	197	197	197
	FF/ENG	2740	2650	2550	2510	2480
160	%N1	45.9	48.4	51.8	55.2	59.2
	KIAS	197	197	197	197	197
	FF/ENG	2630	2540	2430	2380	2330

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight

Advisory Information

Chapter PI

Section 32

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 30

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	220000 KG LANDING WT	PER 5000 KG ABOVE / BELOW 220000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN / UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF30	ONE REV	NO REV

Dry Runway

MAX MANUAL	910	+25/0	20	-35/+125	+10/-10	+20/-20	35	20	40
AUTOBRAKE MAX	1215	+25/0	25	-50/+180	0/0	+30/-30	65	0	0
AUTOBRAKE 4	1575	+35/0	40	-75/+255	0/0	+40/-40	90	0	0
AUTOBRAKE 3	1855	+45/-10	45	-90/+315	0/-10	+50/-50	100	0	0
AUTOBRAKE 2	2045	+50/-20	60	-105/+365	+25/-45	+55/-55	80	65	65
AUTOBRAKE 1	2205	+55/-25	70	-120/+420	+65/-70	+60/-60	80	250	305

Good Reported Braking Action

MAX MANUAL	1270	+25/-5	30	-60/+220	+30/-25	+30/-30	50	80	195
AUTOBRAKE MAX	1320	+25/-5	35	-65/+225	+30/-20	+30/-30	60	85	205
AUTOBRAKE 4	1580	+35/0	40	-75/+260	+10/-5	+40/-40	90	5	35
AUTOBRAKE 3	1855	+45/-10	45	-90/+315	+5/-10	+50/-50	100	0	0
AUTOBRAKE 2	2045	+50/-20	60	-105/+365	+25/-45	+55/-55	80	65	65
AUTOBRAKE 1	2205	+55/-25	70	-120/+420	+65/-70	+60/-60	80	250	305

Medium Reported Braking Action

MAX MANUAL	1695	+40/-15	50	-95/+350	+75/-60	+45/-45	60	215	575
AUTOBRAKE MAX	1695	+40/-15	50	-95/+350	+75/-60	+45/-45	65	210	570
AUTOBRAKE 4	1755	+40/-5	50	-100/+360	+60/-35	+50/-50	90	195	565
AUTOBRAKE 3	1955	+45/-10	50	-105/+385	+40/-35	+55/-55	100	85	390
AUTOBRAKE 2	2095	+50/-20	60	-115/+405	+55/-65	+60/-60	80	115	310
AUTOBRAKE 1	2210	+55/-25	70	-125/+435	+90/-70	+60/-65	80	275	415

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 30

Poor Reported Braking Action

MAX MANUAL	2145	+50/-25	70	-140/+540	+165/-110	+60/-60	70	445	1380
AUTOBRAKE MAX	2150	+55/-25	70	-140/+540	+170/-115	+60/-60	70	445	1385
AUTOBRAKE 4	2150	+55/-20	70	-140/+540	+170/-110	+60/-60	75	445	1385
AUTOBRAKE 3	2220	+55/-20	70	-140/+545	+140/-90	+65/-65	100	395	1340
AUTOBRAKE 2	2320	+55/-25	75	-145/+560	+145/-115	+65/-65	80	345	1265
AUTOBRAKE 1	2380	+60/-30	80	-150/+570	+170/-120	+70/-70	80	440	1220

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 65 m.

For autobrake and manual speedbrakes, increase reference landing distance by 50 m.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Normal Configuration Landing Distance****Flaps 25**

	LANDING DISTANCE AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	220000 KG LANDING WT	PER 5000 KG ABOVE/ BELOW 220000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN / UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF25	ONE REV NO REV

Dry Runway

MAX MANUAL	940	+20/-5	20	-35/+130	+10/-10	+20/-20	35	20	45
AUTOBRAKE MAX	1285	+20/-5	30	-55/+185	0/0	+30/-30	65	0	0
AUTOBRAKE 4	1670	+30/-10	45	-80/+265	0/0	+45/-45	95	0	0
AUTOBRAKE 3	1975	+35/-15	55	-95/+330	0/-15	+55/-55	100	5	5
AUTOBRAKE 2	2165	+40/-25	70	-110/+375	+30/-50	+60/-60	85	90	90
AUTOBRAKE 1	2330	+50/-30	80	-125/+435	+75/-75	+65/-65	80	295	365

Good Reported Braking Action

MAX MANUAL	1325	+20/-10	35	-65/+225	+30/-30	+35/-35	50	90	215
AUTOBRAKE MAX	1380	+25/-10	35	-65/+230	+30/-20	+35/-35	65	95	225
AUTOBRAKE 4	1680	+30/-10	45	-80/+270	+10/-5	+45/-45	95	5	35
AUTOBRAKE 3	1975	+35/-15	55	-95/+330	+5/-15	+55/-55	100	5	5
AUTOBRAKE 2	2165	+40/-25	70	-110/+375	+30/-50	+60/-60	85	90	90
AUTOBRAKE 1	2330	+50/-30	80	-125/+435	+75/-75	+65/-65	80	295	365

Medium Reported Braking Action

MAX MANUAL	1775	+35/-20	55	-100/+360	+75/-60	+50/-50	60	235	635
AUTOBRAKE MAX	1775	+35/-20	55	-100/+360	+80/-60	+50/-50	65	235	630
AUTOBRAKE 4	1855	+35/-10	55	-100/+370	+55/-35	+50/-50	95	195	610
AUTOBRAKE 3	2075	+35/-20	60	-110/+395	+40/-40	+60/-60	100	90	410
AUTOBRAKE 2	2220	+40/-25	70	-120/+420	+65/-70	+65/-65	85	145	350
AUTOBRAKE 1	2340	+50/-30	80	-125/+445	+95/-80	+65/-65	80	315	480

Poor Reported Braking Action

MAX MANUAL	2250	+45/-30	80	-145/+550	+170/-115	+65/-65	70	485	1535
AUTOBRAKE MAX	2255	+50/-30	80	-145/+550	+175/-120	+65/-65	70	490	1535
AUTOBRAKE 4	2255	+50/-30	80	-145/+550	+175/-110	+65/-65	80	490	1535
AUTOBRAKE 3	2350	+45/-25	80	-145/+560	+145/-95	+70/-70	100	415	1470
AUTOBRAKE 2	2445	+50/-35	85	-150/+575	+155/-120	+70/-70	80	390	1395
AUTOBRAKE 1	2510	+55/-35	90	-155/+585	+175/-125	+75/-75	80	490	1360

Reference distance is for sea level, standard day, no wind or slope, VREF25 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 65 m.

For autobrake and manual speedbrakes, increase reference landing distance by 55 m.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Normal Configuration Landing Distance****Flaps 20**

	LANDING DISTANCE AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	220000 KG LANDING WT	PER 5000 KG ABOVE/ BELOW 220000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN / UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF20	ONE REV NO REV

Dry Runway

MAX MANUAL	1005	+25/-10	25	-40/+135	+10/-10	+20/-20	35	25	55
AUTOBRAKE MAX	1390	+20/-15	35	-60/+195	0/0	+35/-35	70	0	0
AUTOBRAKE 4	1820	+30/-20	50	-80/+280	0/0	+50/-50	100	0	0
AUTOBRAKE 3	2160	+40/-30	65	-100/+345	+5/-15	+60/-60	105	5	5
AUTOBRAKE 2	2370	+45/-40	75	-115/+395	+35/-55	+70/-70	90	105	105
AUTOBRAKE 1	2560	+55/-45	90	-135/+455	+80/-85	+75/-75	90	345	420

Good Reported Braking Action

MAX MANUAL	1430	+25/-20	40	-65/+230	+35/-30	+35/-35	50	105	250
AUTOBRAKE MAX	1485	+25/-20	40	-70/+240	+30/-20	+40/-40	65	105	265
AUTOBRAKE 4	1825	+30/-20	50	-85/+285	+10/0	+60/-50	100	10	40
AUTOBRAKE 3	2160	+40/-30	65	-100/+345	+5/-15	+60/-60	105	5	5
AUTOBRAKE 2	2370	+45/-40	75	-115/+395	+35/-55	+70/-70	90	105	105
AUTOBRAKE 1	2560	+55/-45	90	-135/+455	+80/-85	+75/-75	90	345	420

Medium Reported Braking Action

MAX MANUAL	1925	+35/-30	65	-105/+375	+85/-65	+55/-55	65	275	750
AUTOBRAKE MAX	1925	+40/-30	65	-105/+375	+85/-65	+55/-55	70	270	745
AUTOBRAKE 4	2010	+40/-25	65	-105/+385	+60/-40	+55/-60	100	225	710
AUTOBRAKE 3	2260	+40/-35	70	-115/+415	+45/-45	+65/-65	105	100	490
AUTOBRAKE 2	2425	+50/-40	80	-125/+440	+65/-75	+70/-70	90	160	410
AUTOBRAKE 1	2565	+55/-45	95	-135/+470	+100/-90	+75/-75	90	370	550

Poor Reported Braking Action

MAX MANUAL	2450	+55/-45	90	-150/+570	+185/-125	+70/-70	75	565	1815
AUTOBRAKE MAX	2455	+55/-45	90	-150/+570	+190/-130	+70/-70	75	565	1815
AUTOBRAKE 4	2455	+55/-40	90	-150/+570	+190/-120	+70/-70	80	565	1815
AUTOBRAKE 3	2550	+55/-40	90	-155/+580	+160/-100	+75/-75	105	480	1740
AUTOBRAKE 2	2665	+55/-45	95	-160/+595	+165/-125	+80/-80	90	445	1650
AUTOBRAKE 1	2745	+60/-50	100	-165/+610	+190/-140	+80/-80	85	565	1600

Reference distance is for sea level, standard day, no wind or slope, VREF20 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 70 m.

For autobrake and manual speedbrakes, increase reference landing distance by 55 m.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****Dry Runway**

		LANDING DISTANCES AND ADJUSTMENTS (M)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	190000 KG LDG WT	PER 5000 KG ABV/BLW 190000 KG	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	1590	35/-15	50	-90/340	65/-50	40/-40	115	215	600
ANTISKID (FLAPS 30)	VREF30	1580	35/-15	35	-90/335	65/-50	40/-40	110	210	575
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	930	25/-10	20	-35/130	10/-10	20/-20	70	-	45
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	885	20/0	10	-35/125	10/-10	20/-20	70	-	40
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	1105	40/-5	20	-40/140	10/-10	25/-25	65	35	80
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	1010	30/-5	15	-40/130	10/-10	20/-20	70	30	65
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	925	25/-10	20	-35/125	10/-10	20/-20	70	20	50
FLAPS PRIMARY FAIL	VREF20	1050	20/-10	25	-40/140	15/-10	20/-25	90	30	65
FLAP/SLAT CONTROL	VREF20	925	25/-10	20	-35/125	10/-10	20/-20	70	20	50
FLIGHT CONTROL MODE	VREF20	1065	25/-10	25	-40/140	15/-10	25/-25	90	30	70
HYD PRESS SYS C	VREF20	1050	20/-10	25	-40/140	15/-10	20/-25	90	30	65
HYD PRESS SYS L+C	VREF30+20	1280	25/0	20	-50/165	20/-20	30/-30	125	-	60
HYD PRESS SYS L+R	VREF30+20	1385	25/5	20	-55/195	30/-30	35/-35	140	-	-
HYD PRESS SYS R+C	VREF30+20	1565	25/0	25	-65/220	35/-35	40/-40	155	-	140
HYD PRESS SYS L (FLAPS 25)	VREF25	940	20/0	20	-40/130	15/-10	20/-20	80	-	30
HYD PRESS SYS L (FLAPS 30)	VREF30	950	20/0	10	-40/135	15/-10	20/-20	85	-	30
HYD PRESS SYS R (FLAPS 25)	VREF25	1030	15/0	25	-45/155	15/-15	25/-25	90	-	45
HYD PRESS SYS R (FLAPS 30)	VREF30	1035	20/0	15	-45/155	20/-15	25/-25	95	-	45
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	1145	35/-5	20	-40/140	15/-10	25/-25	70	35	85
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	1020	25/-5	15	-40/135	10/-10	20/-20	70	30	65
PRI FLIGHT COMPUTERS	VREF20	1065	25/-10	25	-40/140	15/-10	25/-25	90	30	70
SLATS DRIVE	VREF30+30	1095	30/-5	20	-40/140	15/-10	25/-25	75	35	75
STABILIZER	VREF30+20	1020	25/-5	15	-40/135	10/-10	20/-20	70	30	65

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (305 meters air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****Good Reported Braking Action**

EICAS MESSAGE	VREF	LANDING DISTANCES AND ADJUSTMENTS (M)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
		190000 KG LDG WT	PER 5000 KG ABV/BLW 190000 KG	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	1590	35/-15	50	-90/340	65/-50	40/-40	115	215	600
ANTISKID (FLAPS 30)	VREF30	1580	35/-15	35	-90/335	65/-50	40/-40	110	210	575
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	1345	25/-20	35	-65/230	35/-30	35/-35	105	-	180
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	1250	25/-5	20	-60/220	35/-30	30/-30	100	-	155
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	1580	30/-10	35	-70/240	35/-30	40/-40	95	140	365
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	1425	25/-10	30	-65/230	30/-30	35/-35	100	115	300
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	1290	25/-15	35	-60/220	30/-25	30/-30	95	95	235
FLAPS PRIMARY FAIL	VREF20	1435	25/-20	40	-65/235	35/-30	35/-35	120	115	295
FLAP/SLAT CONTROL	VREF20	1290	25/-15	35	-60/220	30/-25	30/-30	95	95	235
FLIGHT CONTROL MODE	VREF20	1460	25/-20	40	-70/240	35/-30	35/-35	125	120	315
HYD PRESS SYS C	VREF20	1435	25/-20	40	-65/235	35/-30	35/-35	120	115	295
HYD PRESS SYS L+C	VREF30+20	1850	35/-5	35	-85/290	60/-50	50/-50	170	-	270
HYD PRESS SYS L+R	VREF30+20	2000	35/0	35	-95/325	90/-70	55/-55	190	-	-
HYD PRESS SYS R+C	VREF30+20	1880	35/-5	35	-85/290	65/-55	50/-50	175	-	285
HYD PRESS SYS L (FLAPS 25)	VREF25	1370	25/-5	35	-70/240	40/-35	35/-35	120	-	145
HYD PRESS SYS L (FLAPS 30)	VREF30	1375	25/-5	25	-70/245	40/-35	35/-35	125	-	150
HYD PRESS SYS R (FLAPS 25)	VREF25	1370	25/-5	35	-70/240	40/-35	35/-35	120	-	150
HYD PRESS SYS R (FLAPS 30)	VREF30	1365	25/-5	25	-70/240	40/-35	35/-35	120	-	145
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	1610	30/-10	35	-70/240	35/-30	40/-40	100	140	360
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	1420	25/-10	30	-65/230	35/-30	35/-35	100	110	275
PRI FLIGHT COMPUTERS	VREF20	1460	25/-20	40	-70/240	35/-30	35/-35	125	120	315
SLATS DRIVE	VREF30+30	1530	30/-10	30	-70/240	35/-30	40/-40	100	125	315
STABILIZER	VREF30+20	1420	25/-10	30	-65/230	35/-30	35/-35	100	110	275

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (305 meters air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****Medium Reported Braking Action**

		LANDING DISTANCES AND ADJUSTMENTS (M)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	190000 KG LDG WT	PER 5000 KG ABV/BLW 190000 KG	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	1995	45/-25	70	-130/515	145/-100	55/-55	130	445	1475
ANTISKID (FLAPS 30)	VREF30	1970	50/-25	50	-130/510	140/-95	55/-55	125	425	1385
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	1870	40/-30	60	-105/385	95/-75	50/-50	140	-	540
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	1710	40/-15	35	-100/365	85/-65	45/-45	130	-	445
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	2120	45/-25	60	-105/380	80/-65	60/-60	120	370	1115
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	1890	40/-20	50	-100/365	75/-60	50/-50	125	305	895
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	1710	35/-25	55	-95/350	70/-55	45/-45	120	250	705
FLAPS PRIMARY FAIL	VREF20	1870	40/-30	60	-100/370	80/-65	50/-50	145	295	860
FLAP/SLAT CONTROL	VREF20	1710	35/-25	55	-95/350	70/-55	45/-45	120	250	705
FLIGHT CONTROL MODE	VREF20	1905	40/-30	65	-105/375	85/-65	50/-50	150	310	925
HYD PRESS SYS C	VREF20	1870	40/-30	60	-100/370	80/-65	50/-50	145	295	860
HYD PRESS SYS L+C	VREF30+20	2550	55/-20	60	-135/480	150/-115	75/-75	205	-	790
HYD PRESS SYS L+R	VREF30+20	3190	55/-10	70	-175/615	300/-210	95/-95	260	-	-
HYD PRESS SYS R+C	VREF30+20	2585	55/-20	65	-135/485	155/-120	75/-75	210	-	820
HYD PRESS SYS L (FLAPS 25)	VREF25	1925	40/-15	60	-115/415	110/-85	55/-55	155	-	470
HYD PRESS SYS L (FLAPS 30)	VREF30	1925	40/-15	45	-115/415	110/-85	55/-55	155	-	460
HYD PRESS SYS R (FLAPS 25)	VREF25	1915	40/-15	60	-110/415	110/-85	55/-55	155	-	465
HYD PRESS SYS R (FLAPS 30)	VREF30	1880	40/-15	40	-110/410	105/-80	50/-50	145	-	430
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	2115	45/-25	55	-105/380	80/-65	60/-60	120	350	1005
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	1870	40/-20	45	-100/360	75/-60	50/-50	120	280	785
PRI FLIGHT COMPUTERS	VREF20	1905	40/-30	65	-105/375	85/-65	50/-50	150	310	925
SLATS DRIVE	VREF30+30	2005	40/-20	50	-105/375	80/-65	55/-55	120	310	875
STABILIZER	VREF30+20	1870	40/-20	45	-100/360	75/-60	50/-50	120	280	785

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (305 meters air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION

**Non-Normal Configuration Landing Distance
Poor Reported Braking Action**

		LANDING DISTANCES AND ADJUSTMENTS (M)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	190000 KG LDG WT	PER 5000 KG ABV/BLW 190000 KG	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	2620	70/-45	100	-210/930	665/-215	75/-75	145	1265	5000
ANTISKID (FLAPS 30)	VREF30	2570	70/-40	80	-205/920	645/-210	75/-75	140	1200	5000
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	2475	60/-45	90	-160/610	230/-150	75/-75	170	-	1400
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	2230	55/-25	55	-150/580	200/-130	65/-65	150	-	1120
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	2665	65/-35	85	-150/570	170/-120	75/-75	145	750	2780
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	2370	60/-30	70	-145/550	165/-115	65/-65	140	615	2185
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	2145	55/-40	80	-135/530	155/-105	60/-60	140	515	1735
FLAPS PRIMARY FAIL	VREF20	2315	55/-40	85	-145/555	170/-115	65/-65	160	590	2085
FLAP/SLAT CONTROL	VREF20	2145	55/-40	80	-135/530	155/-105	60/-60	140	515	1735
FLIGHT CONTROL MODE	VREF20	2365	60/-45	90	-145/560	175/-120	65/-65	165	625	2265
HYD PRESS SYS C	VREF20	2315	55/-40	85	-145/555	170/-115	65/-65	160	590	2085
HYD PRESS SYS L+C	VREF30+20	3365	80/-35	100	-205/785	385/-230	100/-100	225	-	1945
HYD PRESS SYS L+R	VREF30+20	5110	85/-15	130	-330/1255	1395/-575	165/-160	320	-	-
HYD PRESS SYS R+C	VREF30+20	3395	80/-35	100	-210/790	390/-235	100/-100	230	-	2000
HYD PRESS SYS L (FLAPS 25)	VREF25	2605	60/-25	95	-180/700	305/-180	75/-75	185	-	1250
HYD PRESS SYS L (FLAPS 30)	VREF30	2590	60/-25	70	-180/700	300/-180	75/-75	180	-	1205
HYD PRESS SYS R (FLAPS 25)	VREF25	2575	55/-25	90	-175/695	295/-175	75/-75	180	-	1205
HYD PRESS SYS R (FLAPS 30)	VREF30	2500	60/-25	70	-175/685	280/-170	75/-75	165	-	1085
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	2625	60/-35	80	-150/570	170/-120	75/-75	135	670	2330
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	2325	55/-30	70	-140/545	160/-110	65/-65	135	555	1845
PRI FLIGHT COMPUTERS	VREF20	2365	60/-45	90	-145/560	175/-120	65/-65	165	625	2265
SLATS DRIVE	VREF30+30	2485	60/-35	75	-145/560	165/-115	70/-70	135	600	2010
STABILIZER	VREF30+20	2325	55/-30	70	-140/545	160/-110	65/-65	135	555	1845

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (305 meters air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION**Landing Climb Limit Weight****Valid for approach with flaps 20 and landing with flaps 30**

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
54	129	297.3	279.1				
52	126	306.3	287.0				
50	122	315.2	294.5	269.7			
48	118	323.5	303.4	276.9			
46	115	331.8	312.4	284.1	259.6		
44	111	340.4	321.1	291.5	267.7		
42	108	352.1	329.0	299.1	275.0	251.6	
40	104	359.1	337.3	307.2	281.4	257.0	
38	100	366.2	349.6	316.0	287.8	262.8	233.8
36	97	369.0	356.4	323.2	293.4	269.2	238.4
34	93	369.3	363.2	330.4	299.7	274.4	243.0
32	90	369.5	365.7	338.2	306.4	278.7	247.1
30	86	369.8	365.9	346.1	312.9	282.9	250.9
28	82	370.1	366.0	352.5	318.7	287.3	254.6
26	79	370.3	366.1	352.7	322.6	292.2	258.2
24	75	370.6	366.3	352.8	326.0	297.0	263.1
22	72	370.8	366.4	352.9	327.4	300.3	268.1
20	68	371.1	366.5	352.9	327.5	302.5	272.4
18	64	371.3	366.7	353.0	327.6	304.7	275.2
16	61	371.6	366.8	353.1	327.6	304.7	276.9
14	57	371.8	366.9	353.2	327.7	304.8	278.5
12	54	372.0	367.0	353.3	327.8	304.9	278.6
10	50	372.2	367.2	353.3	327.9	304.9	278.7
8	46	372.3	367.3	353.4	327.9	304.9	278.7
6	43	372.5	367.4	350.4	328.0	304.9	272.8
4	40	372.6	367.4	341.5	313.7	286.7	254.9
2	36	372.7	367.5	341.6	313.8	286.8	254.9
0	32	372.8	367.5	341.6	313.8	286.8	255.0
-40	-40	373.4	367.8	341.6	313.8	286.8	255.0

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.

With engine bleed for packs off, increase weight by 1250 kg.

With engine and wing anti-ice on, decrease weight by 2350 kg.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 26950 kg.

ADVISORY INFORMATION**Landing Climb Limit Weight****Valid for approach with flaps 20 and landing with flaps 25**

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
54	129	302.7	284.5				
52	126	310.0	292.5				
50	122	317.6	300.2	275.6			
48	118	325.1	307.8	282.4			
46	115	332.9	315.3	289.8	267.1		
44	111	340.7	322.9	297.4	273.6		
42	108	351.0	330.3	304.4	280.1	258.9	
40	104	357.8	337.9	311.1	286.7	264.5	
38	100	365.0	348.4	318.5	293.4	269.9	241.1
36	97	367.8	355.1	325.0	299.2	275.1	245.9
34	93	368.0	361.9	331.6	305.0	279.9	250.6
32	90	368.3	364.3	338.6	310.6	284.3	254.9
30	86	368.5	364.5	345.5	315.9	288.7	259.0
28	82	368.8	364.6	351.2	320.8	293.2	262.9
26	79	369.1	364.8	351.4	324.4	298.1	266.5
24	75	369.3	364.9	351.5	327.7	302.6	270.7
22	72	369.6	365.0	351.6	329.0	305.5	274.7
20	68	369.8	365.2	351.6	329.1	307.3	278.2
18	64	370.1	365.3	351.7	329.1	309.0	281.0
16	61	370.3	365.4	351.8	329.2	309.1	282.8
14	57	370.5	365.5	351.9	329.3	309.1	284.4
12	54	370.7	365.7	351.9	329.3	309.2	284.5
10	50	370.9	365.8	352.0	329.4	309.2	284.5
8	46	371.1	365.9	352.1	329.5	309.3	284.6
6	43	371.2	366.0	352.1	329.5	309.3	284.5
4	40	371.3	366.0	352.2	329.6	309.3	278.4
2	36	371.4	366.1	352.2	329.6	309.4	278.4
0	32	371.5	366.1	352.3	329.7	309.4	278.4
-40	-40	372.1	366.4	352.4	329.8	309.5	278.5

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.

With engine bleed for packs off, increase weight by 1400 kg.

With engine and wing anti-ice on, decrease weight by 2300 kg.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 24500 kg.

ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Reference Brake Energy (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)																							
		80				100				120				140				160				180			
WEIGHT (1000 KG)	OAT (°C)	PRESSURE ALTITUDE (1000 FT)																							
		0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8			
360	0	23.3	25.7	28.3	33.8	37.7	41.9	46.1	51.6	57.8	59.8	67.3	75.6	74.5	84.0	94.5	89.8	101.1	113.6						
	10	23.9	26.4	29.2	34.8	38.8	43.2	47.5	53.2	59.6	61.7	69.4	78.0	76.9	86.6	97.4	92.6	104.1	116.9						
	15	24.4	26.9	29.7	35.5	39.5	44.0	48.4	54.2	60.7	62.8	70.6	79.4	78.3	88.1	99.1	94.2	105.9	118.8						
	20	24.8	27.4	30.2	36.1	40.2	44.8	49.2	55.2	61.8	63.9	71.9	80.8	79.6	89.6	100.8	95.8	107.6	120.6						
	30	25.5	28.1	31.0	37.1	41.3	46.1	50.6	56.7	63.6	65.8	74.0	83.1	81.9	92.2	103.6	98.5	110.6	123.9						
340	0	25.7	28.4	31.4	37.7	42.0	46.8	51.5	57.8	64.8	67.1	75.5	84.9	83.7	94.2	105.8	100.7	113.0	126.4						
	10	22.2	24.5	27.0	32.3	35.9	39.9	43.9	49.1	55.0	56.9	64.0	71.9	71.0	79.9	90.0	85.6	96.4	108.4						
	15	22.9	25.2	27.8	33.2	37.0	41.1	45.2	50.6	56.7	58.7	66.0	74.2	73.2	82.4	92.8	88.3	99.3	111.6						
	20	23.3	25.7	28.3	33.9	37.7	41.9	46.1	51.6	57.7	59.8	67.2	75.5	74.5	83.9	94.4	89.8	101.0	113.4						
	30	23.7	26.2	28.8	34.5	38.4	42.7	46.9	52.5	58.8	60.8	68.4	76.8	75.8	85.4	96.0	91.3	102.7	115.3						
320	0	24.3	26.8	29.6	35.4	39.4	43.9	48.2	54.0	60.5	62.6	70.3	79.0	78.0	87.8	98.7	94.0	105.6	118.4						
	10	24.6	27.1	30.0	35.9	40.0	44.6	49.0	55.0	61.6	63.8	71.8	80.7	79.7	89.7	100.8	96.0	107.9	120.9						
	0	21.2	23.4	25.7	30.7	34.2	37.9	41.7	46.6	52.2	54.0	60.7	68.1	67.3	75.8	85.3	81.3	91.5	103.0						
	10	21.8	24.0	26.5	31.6	35.2	39.1	43.0	48.1	53.8	55.7	62.6	70.3	69.5	78.2	88.0	83.8	94.4	106.1						
	15	22.2	24.5	27.0	32.2	35.8	39.8	43.8	49.0	54.8	56.7	63.7	71.5	70.7	79.6	89.5	85.3	96.0	107.9						
300	0	22.6	24.9	27.5	32.8	36.5	40.5	44.6	49.8	55.7	57.7	64.8	72.8	72.0	81.0	91.1	86.8	97.6	109.7						
	10	23.2	25.6	28.2	33.7	37.5	41.6	45.8	51.2	57.3	59.4	66.7	74.9	74.0	83.3	93.7	89.3	100.4	112.7						
	20	23.4	25.8	28.5	34.2	38.0	42.3	46.6	52.2	58.4	60.5	68.0	76.5	75.6	85.1	95.7	91.2	102.6	115.1						
	0	20.2	22.2	24.5	29.2	32.4	36.0	39.5	44.1	49.3	51.1	57.3	64.3	63.7	71.6	80.6	76.8	86.6	97.5						
	10	20.8	22.9	25.1	30.0	33.4	37.0	40.7	45.5	50.8	52.7	59.1	66.4	65.7	73.9	83.1	79.3	89.3	100.4						
260	0	21.2	23.3	25.6	30.6	34.0	37.7	41.5	46.3	51.8	53.6	60.2	67.6	66.8	75.2	84.6	80.7	90.8	102.1						
	10	21.6	23.7	26.1	31.2	34.6	38.4	42.2	47.2	52.7	54.6	61.3	68.8	68.0	76.5	86.1	82.1	92.4	103.8						
	20	22.1	24.3	26.8	32.0	35.5	39.4	43.4	48.5	54.2	56.1	63.0	70.7	70.0	78.8	88.5	84.4	95.0	106.7						
	30	22.3	24.6	27.1	32.4	36.0	40.1	44.1	49.3	55.2	57.2	64.3	72.2	71.4	80.4	90.5	86.3	97.1	109.0						
	40	22.3	24.6	27.1	32.4	36.0	40.1	44.1	49.3	55.2	57.2	64.3	72.2	71.4	80.4	90.5	86.3	97.1	109.0						
220	0	18.2	20.0	21.9	26.1	28.9	32.0	35.1	39.1	43.6	45.2	50.6	56.6	56.1	63.1	70.9	67.7	76.2	85.8						
	10	18.7	20.6	22.5	26.9	29.7	32.9	36.2	40.3	44.9	46.5	52.1	58.4	57.9	65.1	73.1	69.8	78.6	88.5						
	15	19.1	20.9	23.0	27.4	30.3	33.6	36.8	41.1	45.8	47.4	53.1	59.5	58.9	66.2	74.4	71.1	80.0	90.0						
	20	19.4	21.3	23.4	27.9	30.9	34.2	37.5	41.8	46.6	48.3	54.1	60.6	60.0	67.4	75.7	72.4	81.4	91.6						
	30	19.9	21.9	24.0	28.6	31.7	35.1	38.5	43.0	47.9	49.6	55.6	62.3	61.7	69.4	77.9	74.4	83.8	94.2						
180	0	20.1	22.1	24.2	28.9	32.1	35.6	39.1	43.7	48.7	50.5	56.6	63.5	62.9	70.8	79.6	76.0	85.6	96.2						
	0	16.3	17.8	19.5	23.1	25.4	28.1	30.7	34.1	37.9	39.2	43.7	48.9	48.4	54.2	60.8	58.2	65.4	73.5						
	10	16.7	18.3	20.0	23.7	26.2	28.9	31.6	35.1	39.0	40.3	45.1	50.4	49.9	55.9	62.7	60.0	67.4	75.8						
	15	17.1	18.7	20.4	24.2	26.7	29.4	32.2	35.8	39.8	41.1	45.9	51.3	50.8	57.0	63.9	61.1	68.7	77.2						
	20	17.4	19.0	20.8	24.6	27.1	30.0	32.8	36.4	40.5	41.8	46.7	52.2	51.7	58.0	65.0	62.2	69.9	78.5						
	0	17.8	19.5	21.3	25.2	27.8	30.7	33.7	37.4	41.6	43.0	48.1	53.7	53.2	59.6	66.9	63.9	71.9	80.8						
	10	17.9	19.6	21.5	25.5	28.2	31.1	34.1	38.0	42.3	43.7	48.9	54.7	54.1	60.8	68.2	65.2	73.4	82.5						
	0	14.4	15.7	17.1	20.0	22.0	24.2	26.3	29.1	32.2	33.1	36.8	41.0	40.4	45.2	50.5	48.2	54.0	60.6						
	10	14.8	16.1	17.6	20.6	22.6	24.9	27.0	29.9	33.1	34.1	37.9	42.2	41.6	46.5	52.0	49.7	55.7	62.5						
	15	15.1	16.4	17.9	21.0	23.0	25.3	27.5	30.5	33.7	34.7	38.6	43.0	42.4	47.4	53.0	50.6	56.7	63.6						
	20	15.4	16.7	18.2	21.3	23.5	25.8	28.0	31.0	34.4	35.3	39.3	43.8	43.2	48.3	53.9	51.5	57.8	64.8						
	30	15.7	17.1	18.7	21.9	24.1	26.5	28.8	31.8	35.3	36.3	40.4	45.0	44.4	49.6	55.5	53.0	59.4	66.6						
	40	15.8	17.2	18.8	22.1	24.3	26.8	29.1	32.3	35.8	36.8	41.0	45.7	45.1	50.5	56.5	53.9	60.5	68.0						

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.
If ground speed is used for brakes on speed, ignore wind and enter table with sea level, 15°C.

ADVISORY INFORMATION**Recommended Brake Cooling Schedule****Event Adjusted Brake Energy (Millions of Foot Pounds)****No Reverse Thrust**

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)											
EVENT		10	20	30	40	50	60	70	80	90	100	110	120
LANDING	RTO MAX MAN	10	20	30	40	50	60	70	80	90	100	110	120
	MAX MAN	3.6	13.6	23.5	33.2	42.8	52.3	61.8	71.4	81.0	90.6	100.5	110.4
	MAX AUTO	3.5	12.5	21.4	30.2	39.0	47.8	56.8	66.0	75.5	85.5	95.9	106.8
	AUTOBRAKE 4	3.2	11.7	20.0	28.0	36.0	44.0	52.2	60.6	69.4	78.7	88.6	99.2
	AUTOBRAKE 3	2.7	11.0	18.8	26.3	33.7	41.0	48.4	56.1	64.2	72.8	82.0	92.2
	AUTOBRAKE 2	2.3	10.2	17.5	24.5	31.2	37.9	44.6	51.5	58.9	66.7	75.2	84.6
	AUTOBRAKE 1	1.9	9.0	15.6	21.8	27.8	33.8	39.8	45.9	52.4	59.4	66.9	75.1

2 Engine Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)											
EVENT		10	20	30	40	50	60	70	80	90	100	110	120
LANDING	RTO MAX MAN	10	20	30	40	50	60	70	80	90	100	110	120
	MAX MAN	3.4	12.0	21.2	30.6	39.7	48.6	57.4	65.9	74.4	82.8	91.3	99.7
	MAX AUTO	2.0	8.8	15.9	23.2	30.5	38.0	45.7	53.7	62.1	71.0	80.6	90.9
	AUTOBRAKE 4	1.3	5.6	10.9	16.6	22.5	28.3	34.3	40.7	47.5	54.9	63.0	72.0
	AUTOBRAKE 3	0.8	3.1	7.0	11.6	16.2	20.9	25.8	30.9	36.6	42.7	49.6	57.3
	AUTOBRAKE 2	0.0	2.3	5.0	7.8	10.8	14.0	17.4	21.2	25.6	30.4	36.0	42.4
	AUTOBRAKE 1	0.0	1.6	3.3	5.2	7.2	9.4	11.8	14.4	17.4	20.8	24.7	29.2

Cooling Time (Minutes)

		EVENT ADJUSTED BRAKE ENERGY (MILLIONS OF FOOT POUNDS)									
		16 & BELOW	17	18	20	24	28	32	35	36 TO 44	45 & ABOVE
GEAR DOWN	NO SPECIAL	PROCEDURE REQUIRED	1	2	3	4	6	7	7	CAUTION	FUSE PLUG MELT ZONE
INFLIGHT											
GROUND			11	18	26	42	55	66	73		
BTMS	UP TO 2.4	2.4	2.6	2.9	3.4	4.0	4.5	4.9	5.0 TO 6.3	6.3 & ABOVE	

Observe maximum quick turnaround limit.

Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.

Add 1.0 million foot pounds for each taxi mile.

For one brake deactivated, increase brake energy by 10 percent.

For two brakes deactivated, increase brake energy by 20 percent.

When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after one hour. If overheat occurs after takeoff, extend gear soon for at least 8 minutes.

When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not attempt to taxi for one hour. Tire, wheel and brake replacement may be required. If overheat occurs after takeoff, extend gear soon for at least 12 minutes.

Brake temperature monitor system (BTMS) indication on EICAS may be used 10 to 15 minutes after airplane has come to a complete stop, or inflight with gear retracted, to determine recommended cooling schedule. (When inflight with gear extended, the BTMS indications may vary between individual brakes, due to air-stream effects.)

Performance Inflight

Engine Inoperative

Chapter PI

Section 33

ENGINE INOP

Initial Max Continuous %N1

Based on .84M, engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	97.4	97.0	96.7	96.3	95.9	95.9	95.6	95.3	95.0
15	98.2	97.8	97.3	97.0	96.6	96.3	96.0	95.7	95.4
10	99.2	98.9	98.3	97.7	97.2	97.0	96.6	96.3	96.0
5	100.2	100.1	99.7	98.8	98.1	97.8	97.4	97.1	96.8
0	99.3	100.9	101.0	99.9	99.3	98.8	98.3	97.9	97.6
-5	98.4	99.9	101.2	101.3	100.5	100.2	99.7	99.3	98.8
-10	97.4	99.0	100.3	101.6	101.3	101.3	100.7	100.3	100.0
-15	96.5	98.1	99.3	100.6	101.0	102.0	101.1	100.8	100.5
-20	95.6	97.1	98.3	99.6	100.1	101.0	100.1	99.8	99.5
-25	94.6	96.1	97.4	98.6	99.1	100.0	99.1	98.8	98.5
-30	93.7	95.2	96.4	97.6	98.1	99.0	98.1	97.8	97.5
-35	92.7	94.2	95.4	96.6	97.0	97.9	97.1	96.8	96.5
-40	91.7	93.2	94.4	95.6	96.0	96.9	96.1	95.8	95.5

ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
37000 FT to 27000 FT Pressure Altitudes

37000 FT PRESS ALT													TAT (°C)
KIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
280	0.86	94.3	95.4	96.4	97.4	98.4	99.5	100.5	101.4	101.2	100.2	98.9	97.7
240	0.74	96.1	97.2	98.3	99.3	100.4	101.4	102.1	101.9	100.9	99.5	98.1	97.1
200	0.63	95.7	96.7	97.8	98.8	99.9	100.8	101.4	100.9	100.0	98.5	97.0	96.3
35000 FT PRESS ALT													TAT (°C)
KIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
280	0.82	94.6	95.6	96.6	97.7	98.7	99.7	100.7	101.7	101.4	100.4	99.2	98.1
240	0.71	95.1	96.2	97.2	98.3	99.3	100.3	101.3	101.8	100.9	99.8	98.3	97.2
200	0.60	94.8	95.8	96.9	97.9	98.9	99.9	100.9	101.0	100.2	98.8	97.1	96.1
33000 FT PRESS ALT													TAT (°C)
KIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
320	0.89	91.4	92.4	93.4	94.4	95.4	96.4	97.4	98.3	99.3	100.2	99.8	98.8
280	0.79	95.0	96.0	97.1	98.1	99.2	100.2	101.2	102.2	102.4	101.0	100.0	98.7
240	0.68	95.6	96.7	97.8	98.8	99.8	100.9	101.9	102.4	101.8	100.2	98.9	97.5
200	0.58	95.9	97.0	98.0	99.1	100.1	101.1	101.6	101.6	101.0	99.3	97.9	96.4
31000 FT PRESS ALT													TAT (°C)
KIAS	M	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10
320	0.85	92.7	93.8	94.8	95.7	96.7	97.7	98.7	99.6	100.5	100.8	99.7	98.4
280	0.76	96.3	97.4	98.4	99.5	100.5	101.5	102.5	103.5	102.0	100.6	99.1	98.0
240	0.66	97.4	98.4	99.5	100.5	101.5	102.6	103.3	103.0	101.0	99.5	98.1	96.9
200	0.55	97.6	98.7	99.7	100.8	101.8	102.6	102.8	102.0	100.7	98.7	97.2	96.1
29000 FT PRESS ALT													TAT (°C)
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
320	0.82	93.8	94.8	95.8	96.8	97.8	98.7	99.7	100.6	101.6	100.1	98.9	97.8
280	0.73	96.6	97.6	98.6	99.6	100.6	101.6	102.6	102.5	101.0	99.5	98.1	97.1
240	0.63	98.1	99.2	100.2	101.3	102.3	103.3	103.1	101.6	99.8	98.4	97.1	96.0
200	0.53	98.6	99.7	100.7	101.7	102.7	103.2	102.7	101.2	99.4	97.7	96.3	96.2
27000 FT PRESS ALT													TAT (°C)
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
360	0.88	90.2	91.2	92.1	93.0	94.0	94.9	95.8	96.7	97.6	98.5	99.2	98.1
320	0.79	93.4	94.4	95.3	96.3	97.3	98.2	99.2	100.1	101.1	100.6	99.2	98.1
280	0.70	95.4	96.4	97.4	98.4	99.4	100.4	101.3	102.3	101.3	99.7	98.2	97.1
240	0.60	97.2	98.2	99.2	100.3	101.3	102.3	103.0	102.0	99.9	98.5	97.2	96.2
200	0.51	98.4	99.4	100.4	101.5	102.5	103.2	102.7	101.8	99.9	98.1	96.5	95.6

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	37	35	33	31	29	27
ENGINE A/I ON	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
WING A/I ON - PACKS ON	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3
WING A/I ON - PACKS OFF	-0.6	-0.5	-0.5	-0.5	-0.5	-0.4

ENGINE INOP**Max Continuous %N1****Based on engine bleed for packs on or off and anti-ice off****25000 FT to 18000 FT Pressure Altitudes**

25000 FT PRESS ALT			TAT (°C)										
KLAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
360	0.85	91.2	92.2	93.1	94.1	95.0	95.9	96.8	97.7	98.6	99.5	98.9	98.1
320	0.76	93.9	94.8	95.8	96.8	97.7	98.7	99.6	100.5	101.1	99.6	98.5	97.6
280	0.67	95.5	96.5	97.5	98.5	99.4	100.4	101.3	101.5	100.4	98.8	97.5	96.7
240	0.58	97.4	98.5	99.5	100.5	101.5	102.4	102.3	100.9	99.3	97.8	96.7	95.9
200	0.49	99.3	100.3	101.4	102.4	103.4	103.1	102.0	100.6	98.5	97.1	96.1	95.9
24000 FT PRESS ALT			TAT (°C)										
KLAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
360	0.83	91.3	92.3	93.2	94.2	95.1	96.0	96.9	97.8	98.7	99.6	99.4	98.4
320	0.75	93.6	94.6	95.6	96.5	97.5	98.4	99.4	100.3	101.2	100.0	98.8	97.8
280	0.66	95.4	96.4	97.4	98.3	99.3	100.3	101.2	101.8	100.7	99.1	97.8	96.9
240	0.57	97.3	98.3	99.3	100.3	101.3	102.2	102.6	101.4	99.8	98.3	97.1	96.2
200	0.48	98.8	99.9	100.9	101.9	102.9	103.4	102.3	101.0	98.9	97.4	96.3	95.6
22000 FT PRESS ALT			TAT (°C)										
KLAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
360	0.80	92.1	93.0	94.0	94.9	95.8	96.7	97.6	98.5	99.4	100.0	99.0	98.3
320	0.72	94.3	95.3	96.3	97.2	98.1	99.1	100.0	100.9	100.7	99.3	98.2	97.5
280	0.63	96.1	97.1	98.1	99.0	100.0	100.9	101.9	101.3	99.8	98.4	97.3	96.6
240	0.55	97.7	98.7	99.7	100.7	101.7	102.7	102.3	100.9	99.3	97.7	96.8	96.1
200	0.46	99.5	100.5	101.5	102.5	103.5	103.0	101.5	99.9	97.9	96.8	95.9	95.8
20000 FT PRESS ALT			TAT (°C)										
KLAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
360	0.77	93.7	94.6	95.6	96.5	97.4	98.4	99.3	100.2	101.1	102.0	101.3	100.1
320	0.69	95.9	96.9	97.8	98.8	99.7	100.7	101.6	102.6	103.5	101.8	100.4	99.1
280	0.61	97.7	98.7	99.6	100.6	101.6	102.6	103.5	104.3	102.8	100.9	99.4	98.3
240	0.53	98.5	99.5	100.5	101.5	102.4	103.4	104.3	104.1	102.4	100.7	98.7	97.2
200	0.44	98.0	99.0	99.9	100.9	101.9	102.9	103.8	102.6	100.5	98.0	96.2	95.3
18000 FT PRESS ALT			TAT (°C)										
KLAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
360	0.75	94.4	95.4	96.3	97.2	98.2	99.1	100	100.9	101.8	102.0	100.6	99.4
320	0.67	96.7	97.7	98.6	99.6	100.5	101.4	102.4	103.3	102.9	101.2	99.7	98.6
280	0.59	98.5	99.5	100.5	101.5	102.4	103.4	104.3	104.0	102.3	100.4	98.9	97.8
240	0.51	99.6	100.6	101.6	102.6	103.6	104.5	104.9	103.9	101.9	100.0	98.4	97.2
200	0.42	97.2	98.2	99.2	100.1	101.1	101.9	102.0	100.8	98.8	97.3	95.8	94.4

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	25	24	22	20	18
ENGINE A/I ON	-0.2	-0.2	-0.2	-0.2	-0.2
WING A/I ON - PACKS ON	-0.3	-0.3	-0.3	-0.2	-0.3
WING A/I ON - PACKS OFF	-0.4	-0.4	-0.4	-0.3	-0.5

ENGINE INOP

Max Continuous %N1

Based on engine bleed for packs on or off and anti-ice off

16000 FT to 5000 FT Pressure Altitudes

16000 FT PRESS ALT			TAT (°C)										
CIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
360	0.72	94.8	95.8	96.7	97.6	98.6	99.5	100.4	101.3	102.2	103.1	101.7	100.2
320	0.64	96.9	97.9	98.8	99.8	100.7	101.7	102.6	103.5	104.4	102.7	100.9	99.4
280	0.57	98.7	99.7	100.7	101.6	102.6	103.5	104.5	105.4	104.1	102.2	100.3	98.8
240	0.49	99.1	100.1	101.1	102.0	103.0	104.0	104.9	104.5	103.0	100.9	99.2	97.9
200	0.41	96.2	97.2	98.1	99.1	100.0	100.9	101.5	101.3	99.8	98.3	97.0	95.4
14000 FT PRESS ALT			TAT (°C)										
CIAS	M	-20	-15	-10	-5	0	5	10	15	20	25	30	35
360	0.69	94.9	95.9	96.8	97.7	98.6	99.5	100.4	101.3	102.2	102.2	100.8	99.5
320	0.62	97.1	98.1	99.0	99.9	100.9	101.8	102.7	103.6	103.4	101.5	100.0	98.9
280	0.54	99.2	100.1	101.1	102.1	103.0	103.9	104.9	103.6	103.0	101.0	99.5	98.4
240	0.47	97.3	98.2	99.2	100.1	101.0	102.0	102.7	102.5	100.6	99.0	97.8	96.7
200	0.39	96.1	97.0	98.0	98.9	99.8	100.7	101.4	100.7	99.0	97.6	96.5	95.6
12000 FT PRESS ALT			TAT (°C)										
CIAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40
360	0.67	95.4	96.3	97.2	98.1	99.0	99.9	100.8	101.6	102.5	101.3	100.0	99.0
320	0.60	97.3	98.2	99.2	100.1	101.0	101.9	102.8	103.7	102.3	100.6	99.4	98.4
280	0.52	99.7	100.6	101.6	102.5	103.5	104.4	105.3	104.0	102.0	100.2	99.1	98.1
240	0.45	96.5	97.4	98.3	99.3	100.2	101.1	101.4	100.6	99.2	98.0	96.9	96.0
200	0.38	96.7	97.7	98.6	99.5	100.4	101.2	101.3	100.2	98.7	97.4	96.4	95.8
10000 FT PRESS ALT			TAT (°C)										
CIAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40
360	0.65	94.2	95.2	96.1	96.9	97.8	98.7	99.6	100.4	101.3	101.5	100.2	99.1
320	0.58	96.1	97.1	98.0	98.9	99.8	100.7	101.6	102.4	102.6	101.0	99.7	98.6
280	0.51	98.5	99.4	100.4	101.3	102.2	103.1	104.0	104.6	102.3	100.5	99.4	98.4
240	0.43	95.6	96.6	97.5	98.4	99.3	100.2	101.0	101.1	100.3	99.1	97.8	96.9
200	0.36	96.6	97.5	98.4	99.3	100.2	101.1	101.6	101.2	100.1	98.5	97.5	96.6
5000 FT PRESS ALT			TAT (°C)										
CIAS	M	-10	-5	0	5	10	15	20	25	30	35	40	45
360	0.59	92.6	93.5	94.3	95.2	96.0	96.9	97.7	98.5	99.4	100.2	99.3	98.5
320	0.53	94.0	94.9	95.8	96.7	97.5	98.4	99.2	100.1	100.9	100.1	99.1	98.2
280	0.46	95.0	95.9	96.8	97.6	98.5	99.4	100.2	101.1	100.9	99.8	98.8	97.8
240	0.40	95.7	96.6	97.5	98.4	99.3	100.2	101.0	101.6	100.5	99.4	98.3	97.4
200	0.33	97.0	97.9	98.8	99.7	100.6	101.5	102.4	101.7	100.3	99.1	98.1	97.3

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	16	14	12	10	5
ENGINE A/I ON	-0.3	-0.2	-0.4	-0.5	-0.5
WING A/I ON - PACKS ON	-0.4	-0.5	-0.6	-0.7	-0.8
WING A/I ON - PACKS OFF	-0.6	-0.7	-0.8	-0.9	-1.1

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

Includes APU fuel burn

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
360	350	301	18000	16900	15700
340	331	293	19500	18400	17300
320	312	285	20900	20200	19100
300	291	276	22400	21500	20600
280	272	266	24200	23200	22000
260	252	257	26200	25300	24000
240	233	248	28500	27700	26300
220	214	238	30500	30000	28900
200	195	227	32300	32000	31300
180	175	215	34300	34100	33800
160	155	203	36500	36400	36200

ENGINE INOP

MAX CONTINUOUS THRUST

**Driftdown/LRC Cruise Range Capability
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
134	125	118	111	105	100	95	90	86	82	79
268	251	236	222	210	200	190	181	173	166	159
402	376	354	333	316	300	285	272	260	249	239
535	501	471	445	421	400	380	363	347	332	319
668	626	588	555	526	500	476	454	434	416	399
800	750	706	666	631	600	571	545	521	499	479
932	874	823	777	736	700	666	636	608	583	560
1064	998	940	888	841	800	762	727	696	667	640
1196	1122	1057	998	946	900	857	818	783	751	721
1327	1246	1173	1109	1051	1000	952	910	870	835	801
1459	1369	1290	1220	1156	1100	1048	1001	958	918	882
1590	1493	1407	1330	1262	1200	1143	1092	1045	1002	963
1722	1617	1524	1441	1367	1300	1239	1183	1133	1086	1043
1854	1741	1641	1552	1472	1400	1334	1275	1220	1170	1124
1986	1865	1758	1662	1577	1500	1430	1366	1307	1254	1205
2118	1989	1875	1773	1682	1600	1525	1457	1395	1338	1285
2250	2113	1992	1884	1787	1700	1620	1548	1482	1421	1365
2383	2238	2109	1995	1892	1800	1716	1639	1569	1505	1446

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG)											TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 KG)											
	160	180	200	220	240	260	280	300	320	340	360	
100	1.0	1.1	1.2	1.4	1.4	1.6	1.7	1.7	1.8	1.9	2.0	0:15
200	2.3	2.5	2.8	3.0	3.2	3.4	3.6	3.8	4.1	4.3	4.5	0:31
300	3.6	3.9	4.4	4.8	5.1	5.4	5.8	6.1	6.5	6.9	7.2	0:46
400	4.9	5.4	6.0	6.6	7.0	7.5	7.9	8.4	8.9	9.5	10.0	1:01
500	6.2	6.8	7.5	8.2	8.8	9.4	10.0	10.6	11.2	11.9	12.6	1:16
600	7.4	8.1	9.0	9.8	10.6	11.3	12.0	12.7	13.4	14.3	15.2	1:30
700	8.6	9.4	10.4	11.4	12.3	13.1	13.9	14.8	15.6	16.6	17.7	1:45
800	9.7	10.7	11.9	13.0	14.0	14.9	15.9	16.8	17.8	19.0	20.2	1:59
900	10.9	12.0	13.3	14.5	15.6	16.8	17.8	18.9	20.0	21.3	22.7	2:14
1000	12.1	13.3	14.7	16.1	17.3	18.5	19.7	20.9	22.1	23.6	25.2	2:28
1100	13.2	14.6	16.1	17.6	19.0	20.3	21.6	22.9	24.3	25.9	27.6	2:43
1200	14.4	15.9	17.5	19.1	20.6	22.1	23.5	24.9	26.4	28.1	30.0	2:57
1300	15.5	17.2	18.9	20.6	22.3	23.8	25.4	26.9	28.5	30.4	32.4	3:11
1400	16.6	18.4	20.3	22.1	23.9	25.6	27.2	28.9	30.6	32.6	34.8	3:26
1500	17.7	19.6	21.7	23.6	25.5	27.3	29.1	30.9	32.7	34.8	37.2	3:40
1600	18.8	20.9	23.0	25.1	27.1	29.0	30.9	32.8	34.8	37.0	39.5	3:55
1700	19.9	22.1	24.4	26.6	28.7	30.7	32.8	34.8	36.8	39.2	41.9	4:10
1800	21.0	23.3	25.7	28.0	30.2	32.4	34.6	36.7	38.9	41.4	44.2	4:24

Includes APU fuel burn.
Driftdown at optimum driftdown speed and cruise at LRC speed.

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
360	15600	14200	12700
350	16000	14700	13200
340	16900	15200	13700
330	17800	16300	14600
320	18800	17300	15600
310	19800	18300	16600
300	20500	19300	17700
290	21100	20200	18700
280	21800	20800	19800
270	22700	21500	20600
260	23600	22300	21200
250	24600	23400	21900
240	25800	24600	23100
230	27100	25900	24300
220	28500	27300	25600
210	29900	28600	27100
200	30900	30000	28500
190	31900	31200	30100
180	32900	32500	31400
170	34000	33700	32800
160	35200	35100	34300

With engine anti-ice on, no altitude capability adjustment is required.

With engine and wing anti-ice on, decrease altitude capability by 300 ft.

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
360	%N1	90.9	96.3								
	MACH	.602	.664								
	KIAS	334	337								
	FF/ENG	10070	10778								
340	%N1	89.9	94.9	97.6							
	MACH	.602	.664	.683							
	KIAS	334	337	335							
	FF/ENG	9696	10338	10505							
320	%N1	88.7	92.9	94.8	97.7						
	MACH	.602	.653	.670	.689						
	KIAS	334	332	328	325						
	FF/ENG	9267	9589	9644	9735						
300	%N1	86.8	91.0	92.7	94.7	97.9					
	MACH	.592	.638	.657	.674	.694					
	KIAS	329	324	321	317	315					
	FF/ENG	8693	8874	8919	8944	9073					
280	%N1	85.0	89.2	90.8	92.6	94.8	98.3				
	MACH	.574	.622	.641	.660	.677	.700				
	KIAS	319	315	313	310	306	305				
	FF/ENG	8068	8218	8264	8284	8332	8544				
260	%N1	82.9	87.2	88.8	90.5	92.3	94.7	98.4			
	MACH	.557	.605	.623	.643	.662	.679	.704			
	KIAS	309	306	304	302	299	295	294			
	FF/ENG	7484	7593	7619	7642	7676	7747	8011			
240	%N1	80.8	84.8	86.8	88.3	90.0	91.8	94.5	98.3		
	MACH	.540	.585	.605	.624	.644	.663	.681	.707		
	KIAS	299	296	295	293	291	288	284	283		
	FF/ENG	6926	6949	7005	7013	7041	7088	7163	7427		
220	%N1	78.6	82.5	84.2	86.1	87.7	89.4	91.2	93.8	97.8	
	MACH	.522	.564	.584	.604	.623	.644	.663	.681	.708	
	KIAS	289	285	284	283	281	279	276	272	272	
	FF/ENG	6372	6314	6372	6413	6419	6456	6501	6563	6820	
200	%N1	76.2	79.9	81.7	83.4	85.3	86.9	88.6	90.4	93.0	96.9
	MACH	.503	.543	.561	.581	.601	.621	.642	.661	.680	.706
	KIAS	278	274	272	271	270	268	267	264	260	260
	FF/ENG	5827	5717	5752	5795	5829	5836	5870	5906	5957	6195
180	%N1	73.8	77.2	78.9	80.7	82.3	84.2	85.8	87.5	89.3	91.9
	MACH	.484	.521	.538	.556	.575	.596	.616	.638	.658	.677
	KIAS	268	263	261	259	258	257	256	254	251	248
	FF/ENG	5301	5135	5167	5198	5215	5244	5254	5279	5309	5352
160	%N1	71.0	74.3	76.0	77.6	79.3	81.0	82.7	84.5	86.1	88.0
	MACH	.464	.498	.514	.530	.548	.567	.589	.609	.631	.652
	KIAS	257	251	249	247	246	244	243	242	240	238
	FF/ENG	4797	4574	4596	4632	4637	4636	4658	4673	4689	4716

ENGINE INOP

MAX CONTINUOUS THRUST

**Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
284	263	244	227	213	200	190	181	173	166	159
565	523	485	453	425	400	381	364	348	334	321
847	784	728	680	638	600	572	546	522	501	482
1129	1045	970	906	850	800	763	729	698	669	643
1413	1308	1214	1133	1063	1000	954	911	872	836	804
1697	1570	1457	1361	1276	1200	1145	1094	1047	1004	965
1982	1834	1701	1588	1489	1400	1336	1276	1221	1171	1125
2268	2097	1945	1815	1702	1600	1526	1458	1395	1338	1286
2554	2362	2190	2043	1915	1800	1717	1640	1569	1505	1446
2842	2626	2434	2270	2128	2000	1908	1822	1743	1671	1606

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	3.8	0:39	3.3	0:38	3.0	0:36	2.7	0:36	2.5	0:35
400	8.0	1:13	7.3	1:10	6.8	1:08	6.4	1:05	6.1	1:03
600	12.1	1:48	11.2	1:44	10.6	1:39	10.0	1:35	9.7	1:32
800	16.2	2:23	15.1	2:17	14.3	2:11	13.6	2:06	13.2	2:01
1000	20.2	2:59	18.9	2:50	18.0	2:43	17.1	2:36	16.7	2:30
1200	24.2	3:34	22.7	3:24	21.7	3:15	20.7	3:06	20.2	2:59
1400	28.2	4:10	26.5	3:58	25.3	3:47	24.1	3:37	23.6	3:29
1600	32.1	4:46	30.2	4:33	28.9	4:19	27.6	4:08	26.9	3:58
1800	36.0	5:22	33.8	5:07	32.4	4:52	31.0	4:39	30.2	4:28
2000	39.8	5:59	37.5	5:42	36.0	5:25	34.4	5:10	33.5	4:58

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)										
	150	170	190	210	230	250	270	290	310	330	350
5	-1.0	-0.8	-0.6	-0.4	-0.2	0.0	0.3	0.7	1.1	1.7	2.4
10	-2.1	-1.7	-1.3	-0.9	-0.4	0.0	0.7	1.5	2.5	3.7	5.0
15	-3.3	-2.6	-2.0	-1.3	-0.7	0.0	1.0	2.3	3.8	5.6	7.6
20	-4.4	-3.5	-2.7	-1.8	-0.9	0.0	1.4	3.1	5.1	7.4	9.9
25	-5.5	-4.4	-3.4	-2.2	-1.1	0.0	1.8	3.9	6.3	9.1	12.2
30	-6.7	-5.4	-4.0	-2.7	-1.3	0.0	2.1	4.6	7.5	10.7	14.3
35	-7.8	-6.3	-4.7	-3.2	-1.6	0.0	2.5	5.3	8.6	12.2	16.2
40	-8.9	-7.2	-5.4	-3.6	-1.8	0.0	2.8	6.0	9.7	13.7	18.1

Includes APU fuel burn.

ENGINE INOP
MAX CONTINUOUS THRUST

**Holding
Flaps Up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
360	%N1	80.5	83.9	88.6	93.4			
	KIAS	264	264	265	269			
	FF/ENG	9070	9130	9370	9670			
340	%N1	78.7	81.9	86.7	91.4	100.4		
	KIAS	260	260	260	260	299		
	FF/ENG	8520	8560	8730	8950	10320		
320	%N1	76.7	79.7	84.6	89.2	96.4		
	KIAS	253	253	253	253	289		
	FF/ENG	7930	7940	8050	8210	9240		
300	%N1	74.7	77.7	82.3	87.1	92.4		
	KIAS	244	244	244	244	259		
	FF/ENG	7380	7360	7430	7550	8120		
280	%N1	72.8	75.7	80.1	85.0	90.1		
	KIAS	238	238	238	238	238		
	FF/ENG	6880	6850	6880	6950	7350		
260	%N1	70.7	73.6	77.8	82.8	87.8	95.1	
	KIAS	229	229	229	229	229	262	
	FF/ENG	6380	6340	6330	6380	6690	7470	
240	%N1	68.5	71.5	75.6	80.3	85.4	90.5	
	KIAS	223	223	223	223	223	228	
	FF/ENG	5910	5870	5820	5850	6110	6420	
220	%N1	66.2	69.1	73.2	77.7	82.8	87.7	96.7
	KIAS	217	217	217	217	217	217	242
	FF/ENG	5440	5400	5330	5350	5530	5760	6550
200	%N1	64.1	66.7	71.0	75.3	80.1	85.0	91.2
	KIAS	217	217	217	217	217	217	226
	FF/ENG	5010	4970	4910	4900	5040	5200	5550
180	%N1	62.0	64.6	68.6	72.9	77.6	82.5	87.2
	KIAS	217	217	217	217	217	217	217
	FF/ENG	4630	4580	4520	4500	4630	4730	4880
160	%N1	59.9	62.6	66.3	70.7	75.2	80.0	84.7
	KIAS	217	217	217	217	217	217	217
	FF/ENG	4300	4240	4160	4140	4250	4340	4450

This table includes 5% additional fuel for holding in a racetrack pattern.

ENGINE INOP

ADVISORY INFORMATION

**Gear Down Landing Rate of Climb Available
Flaps 20**

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	720	630				
50	780	680	520			
48	830	740	570			
46	880	790	620	480		
44	930	840	670	520		
42	980	900	730	570	420	
40	1020	950	770	620	460	
38	1030	1000	820	660	490	280
36	1030	1030	860	700	520	310
34	1040	1040	910	740	560	340
32	1040	1040	950	780	590	370
30	1050	1040	960	810	630	400
20	1080	1070	980	860	730	530
10	1100	1090	970	850	510	320
0	1120	1110	920	710	500	250
-20	1170	1150	960	740	520	260
-40	1220	1200	990	770	540	270

Rate of climb capability shown is valid for 190000 kg, gear down at VREF20 + 5.

Decrease rate of climb 50 ft/min per 5000 kg greater than 190000 kg.

Increase rate of climb 60 ft/min per 5000 kg less than 190000 kg.

Flaps 30

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	100	10				
50	150	60	-80			
48	200	110	-30			
46	240	160	20	-110		
44	290	210	70	-70		
42	340	260	110	-20	-160	
40	380	310	160	20	-130	
38	380	350	200	50	-100	-300
36	380	390	240	90	-70	-270
34	390	390	280	130	-40	-250
32	390	390	310	160	-10	-220
30	390	390	330	190	20	-200
20	410	400	340	240	110	-80
10	420	410	290	150	10	-150
0	430	420	260	80	-120	-360
-20	450	440	270	80	-120	-370
-40	470	460	280	90	-130	-390

Rate of climb capability shown is valid for 190000 kg, gear down at VREF30 + 5.

Decrease rate of climb 30 ft/min per 5000 kg greater than 190000 kg.

Increase rate of climb 40 ft/min per 5000 kg less than 190000 kg.

Intentionally
Blank

Performance Inflight

Alternate Mode EEC

Chapter PI

Section 34

ALTERNATE MODE EEC

Alternate Mode EEC Max Takeoff %N1

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)											
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	8400
55	131	95.7	96.0	96.2	96.1	96.0	96.1	96.1	96.1	96.1	95.5	94.6	94.2
50	122	97.1	97.5	98.0	97.6	97.3	97.4	97.5	97.5	97.4	96.8	95.9	95.6
45	113	98.5	98.9	99.4	99.1	98.8	98.7	98.8	98.8	98.7	98.2	97.3	96.9
40	104	99.6	100.2	100.9	100.4	100.2	100.0	99.9	100.0	99.9	99.4	98.6	98.2
35	95	99.3	100.8	102.8	102.3	101.8	101.4	101.2	101.3	101.0	100.4	99.6	99.3
30	86	98.5	99.9	102.7	104.0	104.0	103.8	103.4	103.4	102.6	101.5	100.7	100.3
25	77	97.7	99.1	101.8	103.1	104.4	105.5	105.8	106.3	105.3	103.8	102.4	101.8
20	68	96.9	98.3	101.0	102.3	103.5	104.6	105.8	106.8	106.8	105.9	104.8	104.3
15	59	96.0	97.4	100.1	101.4	102.6	103.7	104.9	105.9	106.4	106.1	105.6	105.3
10	50	95.2	96.6	99.2	100.5	101.7	102.8	103.9	105.0	105.5	105.2	104.9	104.8
5	41	94.4	95.7	98.4	99.6	100.8	101.9	103.0	104.1	104.5	104.2	104.0	103.8
0	32	93.5	94.9	97.5	98.7	99.9	101.0	102.1	103.1	103.6	103.3	103.0	102.9
-10	14	91.8	93.1	95.7	96.9	98.1	99.1	100.2	101.2	101.7	101.4	101.1	101.0
-20	-4	90.0	91.3	93.8	95.0	96.2	97.2	98.3	99.3	99.7	99.4	99.2	99.0
-30	-22	88.2	89.5	92.0	93.1	94.3	95.3	96.3	97.3	97.7	97.5	97.2	97.1
-40	-40	86.4	87.6	90.1	91.2	92.3	93.3	94.3	95.3	95.7	95.4	95.2	95.1
-50	-58	84.5	85.7	88.1	89.2	90.3	91.3	92.3	93.2	93.6	93.4	93.1	93.0

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)											
	-2	-1	0	1	2	3	4	5	6	7	8	8.4
PACKS OFF	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3
WING ANTI-ICE ON	-0.2	-0.3	-0.4	-0.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4

Intentionally
Blank

Performance Inflight**Gear Down****Chapter PI****Section 35****GEAR DOWN****220 KIAS Max Climb %N1**

TAT (°C)	PRESSURE ALTITUDE (1000 FT)														
	0	5	10	12	14	16	18	20	22	24	26	28	30	32	34
55	88.2	88.3	91.4	91.1	92.1	91.3	94.0	95.2	95.4	98.1	99.9	101.1	102.4	102.9	103.4
50	89.5	88.8	90.7	90.4	91.4	92.1	93.3	94.5	94.7	97.3	99.2	100.3	101.6	102.1	102.6
45	90.5	90.1	90.0	89.7	90.7	91.4	92.6	93.8	93.9	96.6	98.4	99.6	100.8	101.3	101.8
40	91.6	91.2	91.2	89.7	89.9	90.7	91.9	93.0	93.2	95.8	97.6	98.8	100.0	100.5	101.0
35	92.6	92.3	92.2	92.1	90.6	89.9	91.1	92.3	92.5	95.0	96.8	98.0	99.2	99.7	100.2
30	93.0	93.2	93.2	93.0	92.2	91.2	90.9	91.5	91.7	94.3	96.0	97.2	98.4	98.9	99.4
25	92.2	94.2	94.1	94.0	93.7	92.8	92.1	92.0	91.1	93.5	95.2	96.4	97.6	98.0	98.5
20	91.4	94.2	95.1	95.0	94.9	94.4	93.4	93.0	92.8	93.6	94.4	95.6	96.8	97.2	97.7
15	90.7	93.4	96.7	96.4	96.3	96.1	94.8	94.1	94.5	94.8	95.2	95.3	96.0	96.4	96.9
10	89.9	92.6	96.3	97.9	98.1	98.1	96.8	95.5	96.5	96.2	96.4	96.4	96.6	96.1	96.0
5	89.1	91.7	95.4	97.1	98.9	100.3	99.0	97.9	98.2	97.8	97.8	97.9	97.9	97.3	96.8
0	88.3	90.9	94.6	96.2	98.0	100.1	100.8	100.3	100.1	99.7	99.4	99.4	99.5	98.6	98.1
-5	87.4	90.1	93.7	95.3	97.1	99.1	99.9	100.8	101.9	101.5	101.1	101.1	101.1	100.2	99.6
-10	86.6	89.2	92.8	94.4	96.1	98.2	98.9	99.8	101.4	102.8	102.6	102.6	103.0	101.6	100.8
-15	85.8	88.4	91.9	93.5	95.2	97.3	98.0	98.9	100.4	101.8	102.5	103.2	103.8	102.5	101.4
-20	85.0	87.5	91.1	92.6	94.3	96.3	97.0	97.9	99.4	100.8	101.5	102.2	103.3	102.4	101.3

Anti-ice Adjustment

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)							
	0	5	10	15	20	25	30	35
2 PACKS ON - 1 BLEED SOURCE	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4
1 PACK ON - 1 OR 2 BLEED SOURCES	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4
ENGINE ANTI-ICE ON	-0.3	-0.5	-0.4	-0.3	-0.1	-0.2	-0.2	-0.2
ENGINE AND WING ANTI-ICE ON*	-0.6	-0.8	-0.7	-0.5	-0.2	-0.3	-0.3	-0.4
ENGINE AND WING ANTI-ICE ON**	-1.1	-0.9	-0.9	-0.6	-0.3	-0.4	-0.5	-0.5

* Packs on or off with 2 bleed sources.

** Packs off with 1 bleed source.

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
360	18500	16600	14200
350	19200	17300	14800
340	19700	18000	15500
330	20600	18900	16300
320	21700	20100	17600
310	22800	21300	19000
300	23900	22400	20300
290	25000	23500	21800
280	26000	24600	23000
270	27100	25900	24300
260	28200	27200	25700
250	29400	28600	27100
240	30400	30000	28500
230	31200	30800	29900
220	32000	31700	31000
210	32800	32600	32000
200	33500	33200	32700
190	34000	33900	33400
180	34600	34500	34100
170	35200	35100	34700
160	35800	35700	35300

GEAR DOWN**Long Range Cruise Control**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
360	%N1	84.4	88.7	90.7	93.0						
	MACH	.488	.535	.556	.578						
	KIAS	270	270	270	270						
	FF/ENG	7524	7653	7775	7993						
340	%N1	83.5	87.8	89.7	91.8						
	MACH	.488	.535	.556	.578						
	KIAS	270	270	270	270						
	FF/ENG	7296	7405	7486	7646						
320	%N1	82.6	86.7	88.3	90.0	92.1					
	MACH	.488	.534	.550	.568	.588					
	KIAS	270	269	267	265	264					
	FF/ENG	7058	7105	7101	7142	7267					
300	%N1	81.2	84.9	86.6	88.2	89.9	92.1				
	MACH	.481	.520	.537	.554	.572	.594				
	KIAS	266	262	260	258	257	256				
	FF/ENG	6725	6632	6624	6623	6679	6806				
280	%N1	79.3	83.1	84.9	86.4	87.9	89.7	92.3			
	MACH	.468	.507	.523	.540	.557	.576	.598			
	KIAS	259	255	253	252	250	248	248			
	FF/ENG	6283	6189	6167	6168	6164	6230	6361			
260	%N1	77.2	81.1	82.9	84.6	86.0	87.6	89.4	92.3	96.7	
	MACH	.453	.492	.508	.525	.542	.559	.579	.602	.628	
	KIAS	251	248	246	244	243	241	239	239	239	
	FF/ENG	5831	5754	5724	5709	5711	5706	5778	5910	6239	
240	%N1	75.0	79.0	80.8	82.4	84.1	85.5	87.1	89.0	92.0	
	MACH	.438	.476	.492	.508	.525	.543	.561	.581	.605	
	KIAS	242	240	238	237	235	233	231	230	230	
	FF/ENG	5377	5317	5292	5266	5254	5253	5252	5320	5450	
220	%N1	72.6	76.7	78.4	80.2	81.7	83.4	84.9	86.4	88.4	91.5
	MACH	.421	.459	.475	.491	.508	.525	.543	.561	.582	.606
	KIAS	232	231	230	228	227	225	224	222	221	220
	FF/ENG	4925	4872	4859	4836	4811	4800	4799	4799	4859	4983
200	%N1	69.9	74.1	75.8	77.5	79.3	80.9	82.7	84.4	86.3	88.5
	MACH	.403	.441	.456	.473	.489	.506	.526	.548	.571	.596
	KIAS	223	221	220	219	218	217	217	216	217	217
	FF/ENG	4476	4425	4418	4408	4384	4360	4387	4432	4481	4565
180	%N1	67.8	72.2	74.1	75.9	77.9	79.8	81.5	83.3	85.1	87.0
	MACH	.392	.431	.448	.466	.485	.505	.526	.548	.571	.596
	KIAS	217	217	217	217	217	217	217	216	217	217
	FF/ENG	4152	4138	4141	4159	4170	4182	4208	4249	4283	4335
160	%N1	66.8	71.3	73.1	74.9	76.9	78.7	80.5	82.4	84.1	85.9
	MACH	.392	.431	.448	.466	.485	.505	.526	.548	.571	.596
	KIAS	217	217	217	217	217	217	217	216	217	217
	FF/ENG	4013	3995	3994	4006	4019	4031	4053	4088	4125	4159

GEAR DOWN

**Long Range Cruise Enroute Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
310	280	254	233	216	200	189	179	170	162	155
622	562	510	467	431	400	378	358	340	324	311
936	845	766	702	648	600	567	538	511	487	466
1253	1131	1024	937	864	800	757	718	682	650	621
1573	1418	1283	1173	1081	1000	946	897	852	812	776
1896	1706	1542	1409	1298	1200	1135	1076	1022	973	930
2222	1997	1803	1646	1515	1400	1324	1254	1191	1134	1084
2552	2291	2066	1884	1733	1600	1513	1433	1361	1296	1238
2883	2586	2329	2122	1951	1800	1702	1612	1530	1457	1392
3215	2881	2593	2361	2169	2000	1890	1790	1699	1618	1545
3547	3177	2857	2600	2387	2200	2079	1968	1868	1778	1699
3880	3472	3120	2838	2604	2400	2268	2147	2038	1940	1853
4213	3768	3384	3076	2822	2600	2457	2326	2207	2101	2007
4545	4063	3648	3315	3040	2800	2646	2505	2377	2262	2161
4878	4359	3912	3554	3258	3000	2835	2683	2546	2424	2315
5211	4655	4176	3792	3476	3200	3023	2862	2716	2585	2468
5544	4951	4440	4031	3694	3400	3212	3041	2885	2746	2622
5876	5246	4703	4269	3912	3600	3401	3220	3055	2907	2776
6209	5541	4967	4507	4130	3800	3590	3398	3224	3068	2930
6542	5837	5230	4746	4348	4000	3778	3576	3393	3229	3084

Reference Fuel and Time Required at Check Point

AIR DIST(NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME
	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)
200	7.4	0:46	6.7	0:44	5.8	0:42	5.3	0:41	5.0	0:39
400	15.0	1:29	13.9	1:25	12.4	1:20	11.6	1:17	11.1	1:13
600	22.6	2:13	21.1	2:06	19.0	1:58	17.9	1:53	17.2	1:48
800	30.0	2:57	28.0	2:48	25.4	2:37	24.0	2:30	23.0	2:23
1000	37.3	3:42	34.9	3:30	31.8	3:15	30.1	3:07	28.9	2:57
1200	44.4	4:28	41.6	4:14	38.0	3:55	35.9	3:44	34.5	3:33
1400	51.5	5:14	48.3	4:57	44.1	4:35	41.8	4:22	40.1	4:09
1600	58.3	6:01	54.7	5:41	50.1	5:15	47.5	5:00	45.6	4:45
1800	65.1	6:49	61.2	6:26	56.1	5:56	53.1	5:38	51.0	5:21
2000	71.7	7:37	67.5	7:11	61.9	6:37	58.7	6:17	56.3	5:57
2200	78.3	8:25	73.7	7:56	67.7	7:18	64.2	6:55	61.6	6:33
2400	84.8	9:13	79.9	8:41	73.4	7:59	69.6	7:34	66.8	7:09
2600	91.3	10:00	86.0	9:26	79.1	8:40	75.0	8:12	72.0	7:45
2800	97.6	10:48	92.0	10:11	84.6	9:21	80.3	8:51	77.1	8:21
3000	104.0	11:36	98.0	10:56	90.2	10:02	85.6	9:29	82.1	8:57
3200	110.2	12:24	103.9	11:41	95.7	10:43	90.8	10:08	87.1	9:33
3400	116.5	13:12	109.8	12:27	101.1	11:24	96.0	10:46	92.1	10:09
3600	122.6	14:00	115.6	13:12	106.5	12:05	101.1	11:25	97.0	10:45
3800	128.7	14:48	121.4	13:57	111.9	12:46	106.2	12:03	101.9	11:21
4000	134.8	15:36	127.2	14:42	117.2	13:27	111.3	12:42	106.8	11:57

GEAR DOWN**Long Range Cruise Enroute Fuel and Time****Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)											
	150	170	190	210	230	250	270	290	310	330	350	
10	-1.8	-1.6	-1.3	-0.9	-0.4	0.0	0.8	1.8	2.9	4.1	5.5	
20	-3.6	-3.2	-2.6	-1.8	-0.9	0.0	1.6	3.4	5.5	7.9	10.5	
30	-5.3	-4.7	-3.8	-2.7	-1.4	0.0	2.2	4.9	7.9	11.3	15.1	
40	-6.8	-6.0	-5.0	-3.5	-1.8	0.0	2.9	6.2	10.1	14.4	19.2	
50	-8.3	-7.3	-6.0	-4.2	-2.2	0.0	3.4	7.4	12.0	17.1	22.9	
60	-9.5	-8.4	-6.9	-4.9	-2.5	0.0	3.9	8.4	13.7	19.6	26.1	
70	-10.7	-9.5	-7.8	-5.5	-2.8	0.0	4.3	9.3	15.1	21.6	28.9	
80	-11.7	-10.4	-8.5	-6.1	-3.1	0.0	4.6	10.1	16.3	23.4	31.2	
90	-12.6	-11.2	-9.2	-6.5	-3.4	0.0	4.9	10.7	17.3	24.8	33.1	
100	-13.4	-11.9	-9.8	-7.0	-3.7	0.0	5.1	11.1	18.0	25.9	34.6	
110	-14.1	-12.5	-10.3	-7.3	-3.9	0.0	5.2	11.4	18.5	26.6	35.6	
120	-14.6	-12.9	-10.7	-7.6	-4.0	0.0	5.3	11.6	18.8	27.0	36.1	
130	-15.0	-13.3	-11.0	-7.9	-4.2	0.0	5.3	11.6	18.8	27.0	36.2	
140	-15.2	-13.5	-11.2	-8.1	-4.3	0.0	5.2	11.5	18.6	26.7	35.8	

Descent at VREF30 + 80

PRESSURE ALTITUDE (1000 FT)	17	19	21	23	25	27	29	31	33	35
DISTANCE (NM)	35	40	44	48	52	57	61	65	69	74
TIME (MINUTES)	11	12	13	14	15	15	16	17	18	18

GEAR DOWN

**Holding
Flaps Up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
360	%N1	76.1						
	KIAS	264						
	FF/ENG	7750						
340	%N1	74.6	77.7					
	KIAS	260	260					
	FF/ENG	7360	7350					
320	%N1	72.8	75.8					
	KIAS	253	253					
	FF/ENG	6890	6870					
300	%N1	70.6	73.7	78.1				
	KIAS	244	244	244				
	FF/ENG	6380	6370	6340				
280	%N1	68.8	72.0	76.3				
	KIAS	238	238	238				
	FF/ENG	5970	5960	5920				
260	%N1	66.7	69.7	74.1	78.6			
	KIAS	229	229	229	229			
	FF/ENG	5520	5510	5470	5490			
240	%N1	64.9	67.7	72.2	76.7			
	KIAS	223	223	223	223			
	FF/ENG	5150	5130	5100	5100			
220	%N1	63.1	65.8	70.1	74.6	79.4		
	KIAS	217	217	217	217	217		
	FF/ENG	4800	4770	4730	4730	4770		
200	%N1	61.9	64.7	68.8	73.3	78.0	82.7	
	KIAS	217	217	217	217	217	217	
	FF/ENG	4610	4570	4520	4520	4550	4610	
180	%N1	61.0	63.8	67.8	72.2	76.9	81.5	86.0
	KIAS	217	217	217	217	217	217	217
	FF/ENG	4450	4410	4360	4350	4370	4420	4520
160	%N1	60.1	62.9	66.8	71.3	75.9	80.5	84.9
	KIAS	217	217	217	217	217	217	217
	FF/ENG	4320	4270	4210	4190	4210	4260	4350

This table includes 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN

**Holding
Flaps 1**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
360	%N1	75.9	79.0	83.8	88.3	94.3
	KIAS	244	244	244	244	244
	FF/ENG	7660	7700	7690	7810	8200
340	%N1	74.3	77.4	82.1	86.8	91.8
	KIAS	240	240	240	240	240
	FF/ENG	7240	7260	7250	7350	7630
320	%N1	72.5	75.5	80.0	84.9	89.7
	KIAS	233	233	233	233	233
	FF/ENG	6770	6780	6770	6830	7040
300	%N1	70.3	73.4	77.8	82.9	87.6
	KIAS	224	224	224	224	224
	FF/ENG	6270	6270	6270	6320	6450
280	%N1	68.3	71.5	75.8	80.6	85.6
	KIAS	218	218	218	218	218
	FF/ENG	5840	5840	5820	5870	5980
260	%N1	66.0	69.1	73.5	78.1	83.3
	KIAS	209	209	209	209	209
	FF/ENG	5380	5370	5340	5400	5460
240	%N1	64.1	66.9	71.4	75.9	81.0
	KIAS	203	203	203	203	203
	FF/ENG	4980	4960	4930	4970	5020
220	%N1	62.0	64.7	69.0	73.6	78.4
	KIAS	197	197	197	197	197
	FF/ENG	4600	4570	4530	4550	4610
200	%N1	60.5	63.2	67.3	71.8	76.5
	KIAS	197	197	197	197	197
	FF/ENG	4350	4310	4260	4270	4310
180	%N1	59.1	61.8	65.8	70.3	74.9
	KIAS	197	197	197	197	197
	FF/ENG	4140	4100	4040	4050	4070
160	%N1	57.9	60.7	64.6	69.0	73.5
	KIAS	197	197	197	197	197
	FF/ENG	3970	3920	3860	3860	3860

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight

Gear Down, Engine INOP

Chapter PI

Section 36

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
320	307	254	5600	4400	2200
300	288	246	7700	6800	5300
280	269	238	9800	9100	8100
260	250	230	12100	11400	10300
240	230	223	14000	13500	12400
220	210	217	15900	15400	14400
200	191	216	17300	16700	15700
180	172	216	18500	18100	16900
160	153	216	19700	19400	18200

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
340	1800		
330	3300	1000	
320	4500	2700	
310	5700	4400	1900
300	6800	5700	3800
290	7800	7000	5300
280	8800	8100	6700
270	9800	9100	8100
260	11100	10400	9300
250	12100	11400	10300
240	13100	12500	11300
230	14000	13600	12400
220	15100	14600	13600
210	15900	15400	14400
200	16700	16100	15100
190	17400	16700	15800
180	18000	17500	16400
170	18700	18200	16900
160	19300	18900	17700

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)							
		5	7	9	11	13	15	17	19
300	%N1	94.3	96.8						
	MACH	.403	.418						
	KIAS	244	244						
	FF/ENG	12328	12507						
280	%N1	92.3	94.1	96.8					
	MACH	.393	.407	.422					
	KIAS	238	238	238					
	FF/ENG	11514	11566	11807					
260	%N1	90.5	91.6	93.6	96.4				
	MACH	.385	.393	.408	.423				
	KIAS	233	229	229	229				
	FF/ENG	10870	10626	10714	10945				
240	%N1	88.9	89.8	91.3	93.4	96.5			
	MACH	.379	.385	.397	.412	.428			
	KIAS	229	225	223	223	223			
	FF/ENG	10228	9966	9915	10023	10245			
220	%N1	86.6	88.0	89.1	90.9	93.1	96.4		
	MACH	.368	.377	.387	.401	.417	.433		
	KIAS	223	220	217	217	217	217		
	FF/ENG	9452	9309	9167	9222	9323	9542		
200	%N1	84.2	86.0	87.8	89.5	91.4	94.0	98.1	
	MACH	.358	.371	.385	.400	.415	.431	.448	
	KIAS	217	217	217	217	217	217	217	
	FF/ENG	8693	8698	8718	8773	8844	8956	9300	
180	%N1	82.9	84.7	86.7	88.4	90.2	92.3	95.5	100.2
	MACH	.358	.371	.385	.400	.415	.431	.448	.466
	KIAS	217	217	217	217	217	217	217	217
	FF/ENG	8330	8328	8342	8399	8458	8533	8740	9239
160	%N1	81.7	83.6	85.4	87.3	89.0	90.9	93.5	97.7
	MACH	.358	.371	.385	.400	.415	.431	.448	.466
	KIAS	217	217	217	217	217	217	217	217
	FF/ENG	8019	8011	8010	8058	8115	8168	8310	8670

GEAR DOWN**ENGINE INOP****MAX CONTINUOUS THRUST****Long Range Cruise Diversion Fuel and Time****Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
165	145	129	118	108	100	95	90	84	78	73
332	295	263	238	218	200	187	175	165	155	147
500	444	396	358	327	300	280	262	246	233	221
669	593	528	477	436	400	374	350	329	310	294
837	742	661	597	545	500	467	437	410	387	367
1007	893	795	718	655	600	560	524	492	464	440
1177	1043	928	838	764	700	653	611	574	541	513
1347	1193	1061	958	873	800	746	698	655	618	586
1519	1344	1195	1078	983	900	839	785	737	695	659
1691	1496	1329	1198	1092	1000	933	873	819	772	731

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	6		8		10		12		14	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
100	4.0	0:27	3.8	0:26	3.5	0:26	3.4	0:25	3.3	0:25
200	8.2	0:51	7.8	0:50	7.5	0:49	7.3	0:48	7.2	0:47
300	12.3	1:15	11.8	1:14	11.4	1:12	11.1	1:10	11.1	1:09
400	16.4	1:40	15.8	1:38	15.3	1:36	14.9	1:33	14.9	1:30
500	20.5	2:04	19.7	2:02	19.1	1:59	18.7	1:56	18.7	1:53
600	24.5	2:29	23.6	2:27	22.9	2:23	22.5	2:19	22.4	2:15
700	28.5	2:53	27.5	2:51	26.7	2:46	26.1	2:42	26.0	2:37
800	32.5	3:18	31.3	3:16	30.4	3:10	29.8	3:05	29.6	2:59
900	36.4	3:43	35.1	3:40	34.1	3:34	33.4	3:28	33.2	3:22
1000	40.3	4:08	38.8	4:05	37.8	3:58	37.0	3:51	36.7	3:44

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	150	200	250	300	350
5	-0.8	-0.5	0.0	1.6	2.6
10	-1.8	-1.1	0.0	3.0	5.6
15	-2.8	-1.6	0.0	4.4	8.6
20	-3.7	-2.2	0.0	5.6	11.6
25	-4.5	-2.7	0.0	6.8	14.4
30	-5.4	-3.2	0.0	7.8	17.3
35	-6.2	-3.7	0.0	8.7	20.0
40	-7.0	-4.2	0.0	9.5	22.7
45	-7.7	-4.7	0.0	10.2	25.3

Includes APU fuel burn.

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)			
		1500	5000	10000	15000
340	%N1	95.5			
	KIAS	260			
	FF/ENG	14970			
320	%N1	93.4	97.2		
	KIAS	253	253		
	FF/ENG	13980	14120		
300	%N1	91.1	94.3		
	KIAS	244	244		
	FF/ENG	12970	12940		
280	%N1	89.3	92.3	98.8	
	KIAS	238	238	238	
	FF/ENG	12100	12090	12660	
260	%N1	86.8	90.0	94.8	
	KIAS	229	229	229	
	FF/ENG	11100	11180	11340	
240	%N1	84.6	88.0	92.2	
	KIAS	223	223	223	
	FF/ENG	10310	10380	10460	
220	%N1	82.3	85.7	90.0	96.4
	KIAS	217	217	217	217
	FF/ENG	9540	9590	9650	10020
200	%N1	80.8	84.2	88.6	94.0
	KIAS	217	217	217	217
	FF/ENG	9080	9130	9180	9400
180	%N1	79.6	82.9	87.5	92.3
	KIAS	217	217	217	217
	FF/ENG	8700	8750	8780	8960
160	%N1	78.6	81.7	86.4	90.9
	KIAS	217	217	217	217
	FF/ENG	8380	8420	8430	8580

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight**Text****Chapter PI****Section 37**

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer. In addition, sufficient inflight data is provided to complete a flight with the FMC inoperative. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General**FMC Takeoff Speeds**

FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. This typically occurs at full rated thrust and light weights and is shown in the Minimum Takeoff Weight tables provided in the Performance Dispatch Takeoff section. The options are to select a smaller flaps setting, use reduced takeoff thrust and/or add weight (fuel). Selecting derate thrust is the preferred method of reduced takeoff thrust as this will reduce the minimum control speeds.

Clearway and Stopway V1 Adjustments

Takeoff speed corrections are to be applied to V1 when using takeoff weights based on the use of clearway and stopway.

Adjust V1 by the amount shown in the table. The adjusted V1 must not exceed VR. If V1 is greater than VR, VR may be increased to equal V1. The resultant V2 will be increased by the same amount that VR was increased.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF Speeds

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver speeds. Using VREF as the basis for the schedule makes it variable as a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assume an engine failure at the critical point during the takeoff.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush depths greater than 13mm (0.5 inches) are not recommended because of possible airplane damage as a result of slush impingement on the airplane structure. The use of assumed temperature for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight is determined as follows:

- (1) Determine the dry field/obstacle limit weight for the takeoff flap setting.
- (2) Enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.
- (3) Adjust field length available for temperature by amount shown on chart.

(4) Enter the V1(MCG) Limit Weight table with the field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

(1) Determine takeoff speeds V1, VR and V2 for actual brake release weight using Takeoff Speeds from the Performance Dispatch chapter or from the FMC.

(2) If V1(MCG) limited, set $V1 = V1(MCG)$. If not limited by V1(MCG) considerations, enter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than V1(MCG), set $V1 = V1(MCG)$.

Slippery Runway

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on reversers operating and a 15 ft screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than the minimum V1 for control on the ground, V1(MCG). It is therefore necessary to compare the adjusted V1 to V1(MCG). To find V1(MCG), enter the V1(MCG) table with airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than V1(MCG), set VR equal to V1(MCG) and determine a new V2 by adding the difference between the normal VR and V1(MCG) to the normal V2. No weight adjustment is required provided that the field length available exceeds the minimum field length required shown in the Field and Climb Limit Weight table.

Go-Around %N1

To find Go-Around %N1 based on normal engine bleed for packs on and anti-ice off, enter the Go-Around %N1 table with airport pressure altitude and reported OAT or TAT and read %N1. %N1 adjustments are shown for engine bleeds for various conditions.

Max Climb %N1

This table shows Max Climb %N1 for a 310/.84 climb speed schedule, normal engine bleed for packs on and anti-ice off. Enter the table with airport pressure altitude and TAT and read %N1. %N1 adjustments are shown for anti-ice operation.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Body attitude and average %N1 information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome may also cause unreliable airspeed/Mach indications. Climb, cruise and descent information is based on the recommended turbulent air penetration speed schedule: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and above; maintain a minimum speed of 15 knots above the minimum maneuvering speed when below 0.82 Mach. This schedule provides ample protection from stall and high speed buffet, while also providing protection from exceeding structural limits.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Control

These tables provide target %N1, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude, .84 Mach approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .84/310/250 descent. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent at .84/310/250

Distance and time for descent are shown for a .84/310/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing Flaps 30 at the outer marker.

Holding

Target %N1, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the FMC optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed for the selected flap setting. Flaps 1 is based on VREF30 + 60 speed schedule. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read %N1, IAS and fuel flow per engine.

Advisory Information

Normal Configuration Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and slippery runways with good, medium, and poor reported braking action. These values are actual landing distances and do not include the 1.67 regulatory factor. Therefore, they cannot be used to determine the dispatch required landing field length.

To use these tables, determine the reference landing distance for the selected braking configuration. Then adjust the reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers to obtain the actual landing distance.

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. If the surface is affected by water, snow, or ice, and the braking action is reported as "good", conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate "poor" data reflects runways covered with wet ice.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" braking action, the airplane may not be able to achieve these deceleration rates. In these cases, runway slope and inoperative reversers influence the stopping distance. Since it cannot be determined quickly when this becomes a factor, it is appropriate to add the effects of slope and inoperative reversers when using the autobrake system.

Non-Normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances and adjustments are provided for dry runways and runways with good, medium, and poor reported braking action.

Enter the table with the applicable non-normal configuration and read the normal approach speed. The reference landing distance is a reference distance from 50 ft above the threshold to stop based on a reference landing weight and speed at sea level, zero wind, and zero slope. Subsequent columns provide corrections for off-reference landing weight, altitude, wind, slope, and speed conditions. Each corrections is independently added to the reference landing distance. Landing distance includes the effects of max manual braking and reverse thrust.

For an engine inoperative autoland, check the rate of climb capability shown in Gear Down Landing Rate of Climb Available tables to ensure adequate climb performance.

Landing Climb Limit Weight

In the event an overweight landing is necessary and the fuel dump system is unavailable, landing climb limits should be checked if a Flaps 25 or 30 landing is planned. Enter the table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required. At weights exceeding those shown, plan a Flaps 20 landing.

Recommended Brake Cooling Schedule

Advisory information is provided to assist in avoiding problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Recommended Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind, at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the appropriate Event Adjusted Brake Energy Table (No Reverse Thrust or 2 Engine Reverse) with the reference brake energy per brake and the type of

braking used during landing (Max Manual, Max Auto, or Autobrake). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing. The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Brake Temperature Monitor System (BTMS) indications are also shown. If brake cooling is determined from the BTMS, the hottest brake indication 10 to 15 minutes after the airplane has come to a complete stop, or inflight with gear retracted, may be used to determine recommended cooling schedule by entering at the bottom of the chart. An EICAS advisory message, BRAKE TEMP, will appear when any brake registers 5.0 or higher on the EICAS indication and disappear as the hottest brake cools with an EICAS indication of 3.5. Note that even without an EICAS advisory message, brake cooling is recommended.

Engine Inoperative

Initial Max Continuous %N1

The Initial Max Continuous %N1 setting for use following an engine failure is shown. The table is based on the typical all engine cruise Mach number of .84 to provide a target %N1 setting at the start of driftdown. Once driftdown is established, the Max Continuous %N1 Table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Power setting is based on one engine operating with engine bleed for packs on or off and all anti-ice bleeds off. Enter the table with pressure altitude and IAS or Mach to read %N1.

It is desirable to maintain engine thrust level within the limits of the Max Cruise thrust rating. However, where thrust level in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/Cruise Range Capability

This table shows the range capability from the start of driftdown.

Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to long range cruise speed. Cruise is continued at level off altitude and long range cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and correct for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required. If altitudes other than the level off altitude is used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

Table show the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on LRC speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target %N1, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (KG/HR)				
	GROSS WEIGHT (1000 KG)				
	300	260	220	180	140
43				160	140
39			180	160	145
35		200	190	170	140
31	230	220	195	165	140
25	230	220	195	175	155
20	235	230	205	185	165
15	235	235	215	200	185
10	240	240	230	220	200
5	270	270	255	240	220

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on single engine Long Range Cruise speed and .84/310/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion Table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the off reference fuel corrections table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down Landing Rate of Climb Available

Rate of climb data is provided as guidance information in the event an engine inoperative autoland is planned. The tables show gear down rate of climb available for Flaps 20 and Flaps 30. Enter the table with TAT and pressure altitude to read rate of climb available. Apply adjustments shown to correct for weight.

Alternate Mode EEC

No takeoff speed adjustments or other performance adjustments are required for operation of EEC in the ALTERNATE mode. Power setting adjustments are only required for the takeoff thrust rating.

Max Takeoff %N1

Takeoff power settings are presented for normal air condition bleed. Max Takeoff %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode and maximum rated thrust is reached at a thrust lever position less than full forward. As a result, thrust overboost can occur at full forward thrust lever positions.

Gear Down

This section contains performance for airplane operation with the landing gear extended for all phases of flight. The data is based on engine bleeds for normal air conditioning.

Note: The Flight Management Computer System (FMCS) does not contain special provisions for operation with landing gear extended. As a result, the FMCS will generate inaccurate enroute speed schedules, display non-conservative predictions of fuel burn, estimated time of arrival (ETA), maximum altitude, and compute overly shallow descent path. To obtain accurate ETA predictions, gear down cruise speed and altitude should be entered on the CLB and CRZ pages. Gear down cruise speed should also be entered on the DES page and a STEP SIZE of zero should be entered on the PERF INIT or CRZ page. Use of VNAV during descent under these circumstances is not recommended.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

Intentionally
Blank

Performance Inflight**Chapter PI****Table of Contents****Section 40****777F GE90-110B1L KG JAA**

General	PI.40.1
Maximum Allowable Clearway	PI.40.1
Clearway and Stopway V1 Adjustments	PI.40.1
VREF	PI.40.2
Flap Maneuver Speed	PI.40.3
Slush/Standing Water Takeoff	PI.40.4
Slippery Runway Takeoff	PI.40.8
Minimum Control Speeds	PI.40.12
Go-around %N1	PI.40.13
Max Climb %N1	PI.40.14
Flight With Unreliable Airspeed / Turbulent Air Penetration	PI.40.15
All Engine	PI.41.1
Long Range Cruise Maximum Operating Altitude	PI.41.1
Long Range Cruise Control	PI.41.3
Long Range Cruise Enroute Fuel and Time - Low Altitude	PI.41.4
Long Range Cruise Enroute Fuel and Time - High Altitude	PI.41.5
Long Range Cruise Wind-Altitude Trade	PI.41.6
Descent at .84M/310/250	PI.41.6
Holding	PI.41.7
Advisory Information	PI.42.1
Normal Configuration Landing Distance	PI.42.1
Non-Normal Configuration Landing Distance	PI.42.4
ANTISKID - Flaps 25	PI.42.4
ANTISKID - Flaps 30	PI.42.5
ENG SHUTDOWN L, R - Flaps 20	PI.42.6
ENG SHUTDOWN L, R - Flaps 30	PI.42.7
FLAP / SLAT CONTROL - Flaps 20	PI.42.8
FLAPS DRIVE - (Flaps ≤ 5)	PI.42.9

FLAPS DRIVE - (5 < Flaps < 20)	PI.42.10
FLAPS DRIVE - (Flaps ≥ 20)	PI.42.11
FLAPS PRIMARY FAIL - Flaps 20	PI.42.12
FLIGHT CONTROL MODE - Flaps 20	PI.42.13
HYD PRESS SYS C - Flaps 20	PI.42.14
HYD PRESS SYS L - Flaps 25	PI.42.15
HYD PRESS SYS L - Flaps 30	PI.42.16
HYD PRESS SYS L+C - Flaps 20	PI.42.17
HYD PRESS SYS L+R - Flaps 20	PI.42.18
HYD PRESS SYS R - Flaps 25	PI.42.19
HYD PRESS SYS R - Flaps 30	PI.42.20
HYD PRESS SYS R+C - Flaps 20	PI.42.21
PITCH UP AUTHORITY - (Flaps ≤ 15).	PI.42.22
PITCH UP AUTHORITY - (Flaps ≥ 20).	PI.42.23
PRIMARY FLIGHT COMPUTERS - Flaps 20	PI.42.24
SLATS DRIVE - Flaps 20	PI.42.25
STABILIZER - Flaps 20	PI.42.26
Landing Climb Limit Weight	PI.42.27
Recommended Brake Cooling Schedule.	PI.42.29

Engine Inoperative PI.43.1

Initial Max Continuous %N1	PI.43.1
Max Continuous %N1.	PI.43.2
Driftdown Speed/Level Off Altitude.	PI.43.5
Driftdown/LRC Cruise Range Capability.	PI.43.6
Long Range Cruise Altitude Capability	PI.43.7
Long Range Cruise Control	PI.43.8
Long Range Cruise Diversion Fuel and Time.	PI.43.9
Holding	PI.43.10
Gear Down Landing Rate of Climb Available	PI.43.11

Alternate Mode EEC PI.44.1

Alternate Mode EEC Max Takeoff %N1	PI.44.1
--	---------

777 Flight Crew Operations Manual

Gear Down	PI.45.1
220 KIAS Max Climb %N1	PI.45.1
Long Range Cruise Altitude Capability	PI.45.2
Long Range Cruise Control	PI.45.3
Long Range Cruise Enroute Fuel and Time	PI.45.4
Descent at VREF30 + 80	PI.45.5
Holding	PI.45.6
 Gear Down, Engine Inoperative	 PI.46.1
Driftdown Speed/Level Off Altitude	PI.46.1
Long Range Cruise Altitude Capability	PI.46.1
Long Range Cruise Control	PI.46.2
Long Range Cruise Diversion Fuel and Time	PI.46.3
Holding	PI.46.4
 Text	 PI.47.1
Introduction	PI.47.1
General	PI.47.1
All Engines	PI.47.4
Advisory Information	PI.47.6
Engine Inoperative	PI.47.8
Alternate Mode EEC	PI.47.11
Gear Down	PI.47.11

Intentionally
Blank

Performance Inflight
General

Chapter PI
Section 40

Maximum Allowable Clearway

FIELD LENGTH (M)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (M)
1500	170
2000	210
2500	255
3000	300
3500	340
4000	385
4500	430

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (M)	NORMAL V1 (KIAS)							
	DRY RUNWAY				WET RUNWAY			
	100	120	140	160	100	120	140	160
300	-3	-3	-3	-3				
200	-3	-3	-3	-3				
100	-1	-1	-1	-1				
0	0	0	0	0	0	0	0	0
-100	5	4	3	2	4	2	2	2
-200	7	6	5	4	5	4	4	4
-300	7	6	5	5	7	6	5	4

VREF
Flaps 30

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
360	186	186	186	186	187	187
340	180	180	180	180	180	180
320	173	173	173	173	173	173
300	164	164	164	164	164	165
280	158	158	158	158	158	158
260	149	149	149	150	150	150
240	143	144	144	144	144	144
220	137	137	138	138	138	138
200	137	134	131	131	131	131
180	137	134	130	126	124	124
160	137	134	130	126	121	117

Flaps 25

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
360	185	185	185	185	185	185
340	180	180	180	180	181	181
320	175	175	175	175	175	176
300	169	170	170	170	170	170
280	164	164	164	164	164	164
260	158	158	158	158	158	158
240	152	152	152	152	152	152
220	145	145	146	146	146	146
200	139	139	139	139	139	139
180	137	134	131	131	131	132
160	137	134	130	126	124	124

Flaps 20

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
360	195	195	195	196	196	198
340	190	190	190	191	191	192
320	185	185	185	185	185	186
300	179	179	179	179	180	180
280	173	173	173	173	174	174
260	167	167	167	167	167	167
240	160	160	161	161	161	161
220	154	154	154	154	154	154
200	147	147	147	147	147	147
180	139	139	139	139	139	139
160	137	134	131	131	131	131

Flap Maneuver Speed

FLAP POSITION	MANEUVER SPEED
FLAPS 0	VREF30 + 80
FLAPS 1	VREF30 + 60
FLAPS 5	VREF30 + 40
FLAPS 15	VREF30 + 20
FLAPS 20	VREF30 + 20
FLAPS 25	VREF25
FLAPS 30	VREF30

ADVISORY INFORMATION

Slush/Standing Water Takeoff

Maximum Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-46.6	-52.1	-57.5	-54.5	-60.0	-65.4	-68.0	-73.4	-78.9
380	-43.7	-49.1	-54.6	-51.1	-56.5	-61.9	-63.3	-68.8	-74.2
360	-40.8	-46.2	-51.7	-47.6	-53.0	-58.5	-58.7	-64.2	-69.6
340	-37.8	-43.2	-48.7	-44.0	-49.5	-54.9	-54.0	-59.5	-64.9
320	-34.7	-40.1	-45.6	-40.3	-45.7	-51.2	-49.2	-54.6	-60.0
300	-31.4	-36.8	-42.3	-36.3	-41.8	-47.2	-44.1	-49.6	-55.0
280	-27.9	-33.4	-38.8	-32.2	-37.7	-43.1	-38.9	-44.3	-49.8
260	-24.4	-29.8	-35.2	-27.9	-33.3	-38.8	-33.5	-38.9	-44.4
240	-20.6	-26.0	-31.5	-23.4	-28.8	-34.3	-27.9	-33.4	-38.8
220	-16.7	-22.1	-27.6	-18.7	-24.1	-29.5	-22.2	-27.6	-33.1
200	-12.6	-18.1	-23.5	-13.8	-19.2	-24.6	-16.3	-21.7	-27.1
180	-8.4	-13.9	-19.3	-8.6	-14.1	-19.5	-10.2	-15.6	-21.1
160	-4.2	-9.6	-15.0	-3.5	-8.9	-14.4	-4.0	-9.4	-14.9

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2200				133.1			154.8		
2400	154.6			167.7			189.4		
2600	188.9	124.0		202.3	136.9		224.3	158.6	
2800	223.6	158.3		237.3	171.5		259.5	193.2	127.8
3000	258.7	192.7	127.7	272.7	206.1	140.7	295.1	228.1	162.4
3200	294.3	227.4	162.1	308.6	241.2	175.3	331.1	263.4	197.0
3400	330.4	262.6	196.5	345.0	276.7	210.0	367.5	299.0	232.0
3600	367.0	298.3	231.3	381.7	312.6	245.0		335.1	267.3
3800		334.4	266.5		349.0	280.6		371.5	303.0
4000		371.1	302.2		385.8	316.6			339.1
4200			338.5			353.0			375.5
4400			375.1			389.8			

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -65 m/+65 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slush/Standing Water Takeoff
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-29	-27	-25	-25	-23	-21	-16	-14	-12
340	-31	-29	-27	-26	-24	-22	-17	-15	-13
320	-32	-30	-28	-27	-25	-23	-18	-16	-14
300	-32	-30	-28	-28	-26	-24	-19	-17	-15
280	-32	-30	-28	-28	-26	-24	-20	-18	-16
260	-32	-30	-28	-28	-26	-24	-22	-20	-18
240	-31	-29	-27	-29	-27	-25	-23	-21	-19
220	-31	-29	-27	-29	-27	-25	-24	-22	-20
200	-31	-29	-27	-29	-27	-25	-25	-23	-21
180	-31	-29	-27	-30	-28	-26	-26	-24	-22
160	-32	-30	-28	-30	-28	-26	-27	-25	-23

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slush/Standing Water Takeoff

No Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-61.2	-66.6	-72.1	-70.8	-76.3	-81.7	-86.6	-92.0	-97.5
380	-57.3	-62.8	-68.2	-66.2	-71.6	-77.0	-80.3	-85.7	-91.2
360	-53.5	-59.0	-64.4	-61.5	-66.9	-72.4	-74.0	-79.4	-84.9
340	-49.7	-55.1	-60.5	-56.7	-62.2	-67.6	-67.7	-73.1	-78.6
320	-45.7	-51.1	-56.5	-51.9	-57.4	-62.8	-61.4	-66.8	-72.3
300	-41.5	-47.0	-52.4	-47.0	-52.4	-57.9	-55.1	-60.5	-66.0
280	-37.3	-42.7	-48.1	-42.0	-47.4	-52.8	-48.8	-54.3	-59.7
260	-32.9	-38.3	-43.8	-36.8	-42.3	-47.7	-42.6	-48.0	-53.5
240	-28.3	-33.8	-39.2	-31.6	-37.0	-42.5	-36.3	-41.8	-47.2
220	-23.7	-29.1	-34.6	-26.2	-31.7	-37.1	-30.1	-35.5	-41.0
200	-18.9	-24.3	-29.8	-20.8	-26.2	-31.7	-23.9	-29.3	-34.8
180	-14.0	-19.4	-24.9	-15.3	-20.7	-26.1	-17.7	-23.1	-28.6
160	-9.0	-14.5	-19.9	-9.7	-15.1	-20.6	-11.5	-16.9	-22.4

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
3200							130.5		
3400							177.6		
3600							223.1	127.1	
3800				166.4			265.4	174.2	
4000	133.8			220.4			304.9	220.0	123.7
4200	198.1			267.2	162.3		342.1	262.4	170.8
4400	251.9	129.2		308.9	216.8		377.7	302.1	216.8
4600	297.1	193.7		347.0	264.0	158.3		339.5	259.5
4800	336.8	248.3	124.5	382.7	306.1	213.1		375.2	299.3
5000	372.9	294.0	189.3		344.3	260.8			336.9
5200		334.1	244.8		380.1	303.2			372.6
5400		370.4	290.9			341.7			
5600			331.3			377.6			

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -100 m/+100 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION**Slush/Standing Water Takeoff****No Reverse Thrust****V1 Adjustment (KIAS)**

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-45	-41	-37	-39	-35	-31	-26	-22	-18
340	-47	-43	-39	-40	-36	-32	-27	-23	-19
320	-47	-43	-39	-42	-38	-34	-29	-25	-21
300	-48	-44	-40	-43	-39	-35	-31	-27	-23
280	-48	-44	-40	-43	-39	-35	-33	-29	-25
260	-48	-44	-40	-44	-40	-36	-35	-31	-27
240	-47	-43	-39	-44	-40	-36	-37	-33	-29
220	-47	-43	-39	-45	-41	-37	-39	-35	-31
200	-48	-44	-40	-46	-42	-38	-41	-37	-33
180	-48	-44	-40	-47	-43	-39	-43	-39	-35
160	-49	-45	-41	-48	-44	-40	-44	-40	-36

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
Weight Adjustments (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0.0	-0.1	-1.9	-20.7	-22.5	-24.4	-40.6	-42.4	-44.2
380	-1.2	-3.0	-4.8	-22.4	-24.2	-26.0	-40.6	-42.4	-44.2
360	-4.1	-6.0	-7.8	-24.1	-25.9	-27.7	-40.6	-42.4	-44.2
340	-6.6	-8.4	-10.2	-25.3	-27.1	-28.9	-40.2	-42.0	-43.8
320	-7.8	-9.6	-11.5	-25.1	-27.0	-28.8	-38.6	-40.4	-42.3
300	-7.8	-9.6	-11.4	-23.8	-25.6	-27.4	-36.0	-37.8	-39.6
280	-6.9	-8.7	-10.5	-21.4	-23.2	-25.1	-32.6	-34.4	-36.2
260	-5.9	-7.7	-9.6	-19.1	-20.9	-22.7	-29.1	-30.9	-32.7
240	-5.0	-6.8	-8.6	-16.8	-18.6	-20.4	-25.5	-27.4	-29.2
220	-4.1	-5.9	-7.8	-14.5	-16.3	-18.1	-22.0	-23.8	-25.6
200	-3.3	-5.1	-6.9	-12.2	-14.0	-15.8	-18.4	-20.2	-22.0
180	-2.5	-4.3	-6.1	-9.9	-11.7	-13.5	-14.8	-16.6	-18.4
160	-1.6	-3.5	-5.3	-7.7	-9.5	-11.3	-11.1	-13.0	-14.8

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1600	142.0								
1800	209.7	143.6							
2000	277.1	211.3	145.2						
2200	344.2	278.7	212.9	167.0					
2400		345.8	280.3	215.2	150.7				
2600			347.4	265.0	198.6	134.3	138.0		
2800				316.4	247.8	182.2	169.4		
3000				369.7	298.6	230.8	201.0	137.6	
3200					351.3	281.0	233.5	169.0	
3400						333.1	267.0	200.6	137.2
3600						386.8	301.7	233.1	168.7
3800							337.7	266.6	200.2
4000							374.9	301.3	232.7
4200								337.2	266.2
4400								374.5	300.8

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust “Good” field length available by -35 m/+35 m for every 5°C above/below 4°C.
Adjust “Medium” field length available by -45 m/+45 m for every 5°C above/below 4°C.
Adjust “Poor” field length available by -65 m/+65 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
V1 Adjustments (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-9	-7	-5	-21	-19	-17	-36	-34	-32
340	-11	-9	-7	-24	-22	-20	-39	-37	-35
320	-13	-11	-9	-26	-24	-22	-41	-39	-37
300	-13	-11	-9	-27	-25	-23	-42	-40	-38
280	-14	-12	-10	-28	-26	-24	-43	-41	-39
260	-14	-12	-10	-28	-26	-24	-44	-42	-40
240	-14	-12	-10	-29	-27	-25	-45	-43	-41
220	-15	-13	-11	-29	-27	-25	-45	-43	-41
200	-16	-14	-12	-30	-28	-26	-46	-44	-42
180	-17	-15	-13	-32	-30	-28	-47	-45	-43
160	-18	-16	-14	-33	-31	-29	-48	-46	-44

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slippery Runway Takeoff

No Reverse Thrust

Weight Adjustment (1000 KG)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-5.8	-7.7	-9.5	-36.3	-38.1	-39.9	-61.5	-63.3	-65.1
380	-8.4	-10.2	-12.0	-36.6	-38.4	-40.2	-59.5	-61.3	-63.1
360	-11.0	-12.8	-14.6	-36.9	-38.7	-40.5	-57.5	-59.3	-61.1
340	-13.1	-14.9	-16.7	-36.8	-38.7	-40.5	-55.2	-57.0	-58.9
320	-14.1	-15.9	-17.7	-35.9	-37.7	-39.5	-52.3	-54.1	-55.9
300	-13.9	-15.7	-17.5	-33.9	-35.7	-37.5	-48.6	-50.5	-52.3
280	-12.9	-14.7	-16.5	-31.2	-33.1	-34.9	-44.5	-46.3	-48.1
260	-11.8	-13.6	-15.4	-28.5	-30.3	-32.1	-40.3	-42.1	-43.9
240	-10.6	-12.4	-14.2	-25.6	-27.4	-29.2	-36.0	-37.8	-39.6
220	-9.4	-11.2	-13.0	-22.6	-24.4	-26.2	-31.6	-33.5	-35.3
200	-8.1	-9.9	-11.7	-19.5	-21.3	-23.1	-27.3	-29.1	-30.9
180	-6.8	-8.6	-10.4	-16.2	-18.1	-19.9	-22.8	-24.6	-26.4
160	-5.5	-7.3	-9.1	-13.0	-14.8	-16.6	-18.4	-20.2	-22.0

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2000	160.6								
2200	267.0	170.8							
2400	350.7	274.9	180.9						
2600		357.2	282.6						
2800			363.7						
3200				220.8					
3400				315.4	182.3				
3600				385.0	292.7	138.1			
3800					366.4	267.6			
4000						347.5			
5000							193.4		
5200							265.6	140.7	
5400							334.4	215.0	
5600								286.2	162.6

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -35 m/+35 m for every 5°C above/below 4°C.
Adjust "Medium" field length available by -60 m/+60 m for every 5°C above/below 4°C.
Adjust "Poor" field length available by -90 m/+90 m for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	-13	-9	-5	-31	-27	-23	-57	-53	-49
340	-15	-11	-7	-33	-29	-25	-61	-57	-53
320	-16	-12	-8	-36	-32	-28	-64	-60	-56
300	-18	-14	-10	-38	-34	-30	-67	-63	-59
280	-19	-15	-11	-40	-36	-32	-69	-65	-61
260	-20	-16	-12	-42	-38	-34	-71	-67	-63
240	-21	-17	-13	-43	-39	-35	-73	-69	-65
220	-22	-18	-14	-45	-41	-37	-75	-71	-67
200	-23	-19	-15	-47	-43	-39	-77	-73	-69
180	-24	-20	-16	-50	-46	-42	-79	-75	-71
160	-26	-22	-18	-53	-49	-45	-81	-77	-73

- 1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
- 2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

Minimum Control Speeds
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		-2000		0		2000		4000		6000		8000	
°C	°F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	125	127	121	124	119	122	117	120	115	118	111	114
50	122	129	131	125	128	119	122	117	120	115	118	111	114
40	104	136	138	133	135	127	130	122	125	117	120	111	114
30	86	138	140	138	140	133	136	128	130	122	125	115	118
20	68	139	140	138	140	134	137	131	133	126	129	119	123
-60	-76	140	140	139	140	136	137	132	133	127	129	121	124

Go-around %N1**Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off**

REPORTED OAT		TAT	AIRPORT PRESSURE ALTITUDE (1000 FT)													
°C	°F	°C	-2	-1	0	1	2	3	4	5	6	7	8	9	10	
66	150	70	93.2	93.3	93.6	93.4	93.3	93.3	93.3	93.4	93.3	92.6	91.5	90.5	89.6	
56	133	60	95.9	96.1	96.4	96.2	96.1	96.1	96.1	96.2	96.1	95.4	94.3	93.4	92.5	
51	124	55	97.2	97.6	97.9	97.7	97.5	97.5	97.5	97.5	97.4	96.7	95.7	94.7	93.9	
46	115	50	98.5	98.9	99.3	99.2	98.9	98.8	98.8	98.8	98.7	98.0	97.0	96.1	95.2	
41	106	45	99.6	100.1	100.6	100.5	100.2	100.2	100.1	100.2	100.0	99.3	98.3	97.3	96.5	
36	97	40	100.4	101.6	102.4	102.3	101.9	101.8	101.7	101.7	101.3	100.5	99.5	98.6	97.8	
31	88	35	99.6	101.2	103.2	104.4	103.9	103.7	103.6	103.5	102.7	101.7	100.6	99.7	98.9	
26	79	30	98.8	100.4	102.3	103.8	105.1	105.9	105.9	106.1	105.0	103.4	101.9	100.8	100.0	
21	70	25	97.9	99.5	101.5	102.9	104.2	105.2	106.3	107.2	106.8	105.7	104.0	102.3	101.3	
16	61	20	97.1	98.7	100.6	102.0	103.3	104.3	105.4	106.5	106.8	106.3	105.2	104.2	103.3	
11	53	15	96.3	97.9	99.8	101.2	102.4	103.4	104.5	105.6	105.9	105.5	104.9	104.4	104.0	
7	44	10	95.4	97.0	98.9	100.3	101.5	102.5	103.6	104.6	105.0	104.6	104.0	103.5	103.4	
2	35	5	94.6	96.1	98.0	99.4	100.6	101.6	102.7	103.7	104.1	103.7	103.1	102.5	102.5	
-3	26	0	93.7	95.3	97.1	98.5	99.7	100.7	101.7	102.8	103.1	102.7	102.1	101.6	101.6	
-13	8	-10	92.0	93.5	95.3	96.7	97.9	98.8	99.8	100.9	101.2	100.8	100.3	99.7	99.7	
-23	-10	-20	90.2	91.7	93.5	94.8	96.0	96.9	97.9	98.9	99.3	98.9	98.3	97.8	97.8	
-33	-27	-30	88.4	89.9	91.7	92.9	94.1	95.0	96.0	97.0	97.3	96.9	96.4	95.9	95.8	
-43	-45	-40	86.6	88.0	89.7	91.0	92.1	93.0	94.0	95.0	95.3	94.9	94.4	93.9	93.9	
-53	-63	-50	84.7	86.1	87.8	89.0	90.1	91.0	91.9	92.9	93.2	92.9	92.3	91.8	91.8	

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)												
	-2	-1	0	1	2	3	4	5	6	7	8	9	10
PACKS OFF	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
1 PACK ON	-0.2	-0.2	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3	-0.3
WING ANTI-ICE ON	-0.2	-0.3	-0.4	-0.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4

Max Climb %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)									
	0	5	10	15	20	25	30	35	40	43
	310	310	310	310	310	310	310	.84	.84	.84
60	88.3	88.1	90.3	91.0	93.1	96.7	99.6	101.7	101.8	101.3
50	90.6	90.4	90.2	89.6	91.7	95.3	98.0	100.1	100.2	99.7
40	92.5	92.4	92.4	92.2	90.5	93.8	96.5	98.6	98.7	98.2
30	91.6	94.1	94.2	94.0	93.1	94.2	95.2	97.0	97.1	96.6
20	90.1	92.5	95.1	95.8	95.9	95.9	96.9	95.9	95.5	95.0
15	89.3	91.7	94.3	96.9	96.9	96.9	97.8	96.6	95.8	95.4
10	88.6	90.9	93.5	96.1	98.4	98.1	98.8	97.2	96.5	96.0
5	87.8	90.1	92.7	95.2	98.1	99.6	100.1	98.1	97.2	96.8
0	87.0	89.3	91.8	94.4	97.3	99.9	101.5	99.3	98.1	97.6
-5	86.2	88.5	91.0	93.5	96.4	99.0	101.9	100.5	99.5	98.8
-10	85.4	87.7	90.1	92.6	95.5	98.1	100.9	101.3	100.5	100.0
-15	84.6	86.8	89.3	91.7	94.5	97.1	100.0	101.0	100.9	100.5
-20	83.7	86.0	88.4	90.8	93.6	96.2	99.0	100.1	99.9	99.5
-25	82.9	85.1	87.5	89.9	92.7	95.2	98.0	99.1	98.9	98.5
-30	82.1	84.3	86.7	89.0	91.8	94.3	97.0	98.1	97.9	97.5
-35	81.2	83.4	85.8	88.1	90.8	93.3	96.0	97.0	96.9	96.5
-40	80.4	82.5	84.9	87.2	89.8	92.3	95.0	96.0	95.9	95.5

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)									
	0	5	10	15	20	25	30	35	40	43
2 PACKS ON - 1 BLEED SOURCE	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4	-0.4	-0.5
1 PACK ON - 1 OR 2 BLEED SOURCES	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4	-0.4	-0.5
ENGINE ANTI-ICE ON	-0.3	-0.5	-0.4	-0.3	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
ENGINE AND WING ANTI-ICE ON*	-0.6	-0.8	-0.7	-0.5	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4
ENGINE AND WING ANTI-ICE ON**	-1.1	-0.9	-0.9	-0.6	-0.3	-0.4	-0.5	-0.5	-0.6	-0.6

*Packs on or packs off with 2 bleed sources.

**Packs off with 1 bleed source.

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb**Flaps Up, Set Max Climb Thrust**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		150	200	250	300	350
40000 (.82M)	PITCH ATT V/S (FT/MIN)	5.0 2500	4.5 1500			
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	6.5 3700	5.5 2600	5.5 1800	5.0 1300	4.5 900
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	9.5 5000	8.5 3600	8.0 2700	7.5 2000	7.5 1400
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	14.0 6700	11.5 4900	10.0 3700	9.5 2900	9.5 2200
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	17.5 7800	14.5 5700	12.5 4400	11.5 3500	11.0 2800

Cruise**Flaps Up, %N1 for Level Flight**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		150	200	250	300	350
40000 (.82M)	PITCH ATT %N1	2.0 78.6	3.0 83.2			
35000 (.82M)	PITCH ATT %N1	1.5 76.5	2.0 78.9	3.0 82.8	3.5 88.0	
30000 (280 KIAS)	PITCH ATT %N1	1.5 72.6	2.5 74.7	3.0 78.1	3.5 82.4	3.5 87.3
25000 (280 KIAS)	PITCH ATT %N1	1.5 68.6	2.5 70.7	3.5 73.8	4.0 77.7	4.0 82.3
20000 (270 KIAS)	PITCH ATT %N1	2.0 63.4	2.5 65.8	3.5 69.0	4.5 72.8	5.5 77.4
15000 (270 KIAS)	PITCH ATT %N1	1.5 59.6	2.5 61.8	3.5 65.0	4.5 68.2	5.5 72.5

Descent**Flaps Up, Set Idle Thrust**

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		150	200	250	300	350
40000 (.82M)	PITCH ATT V/S (FT/MIN)	-1.5 -2900	0.0 -2600			
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	-1.5 -2500	-0.5 -2000	0.5 -1900	1.0 -1900	0.5 -2400
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	-1.0 -1900	0.5 -1600	1.5 -1500	2.5 -1400	3.0 -1400
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	-1.5 -1700	0.0 -1400	1.0 -1300	2.0 -1300	3.0 -1300
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	-2.0 -1500	-0.5 -1300	1.0 -1200	2.0 -1200	3.0 -1200

In shaded areas, data reflects the minimum speed limitation of 15 knots above minimum maneuvering speed.

Flight With Unreliable Airspeed / Turbulent Air Penetration
Altitude and/or vertical speed indications may also be unreliable.

Holding

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		150	200	250	300	350
10000	PITCH ATT	3.0	4.5	5.5	6.0	6.0
	%N1	50.2	54.4	59.1	63.9	68.2
	KIAS	216	216	226	244	262
5000	PITCH ATT	3.0	4.5	5.5	6.0	6.0
	%N1	46.6	50.9	55.4	59.7	64.2
	KIAS	216	216	226	244	262

Terminal Area (5000 FT)

%N1 for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		150	200	250	300	350
FLAPS UP GEAR UP (VREF 30 + 80)	PITCH ATT	3.5	5.0	6.0	6.5	6.5
	%N1	47.7	52.3	57.2	61.9	66.4
	KIAS	217	217	225	243	263
FLAPS 1 GEAR UP (VREF 30 + 60)	PITCH ATT	5.0	6.5	8.0	8.0	8.0
	%N1	48.5	53.4	58.8	63.9	68.2
	KIAS	197	197	205	223	243
FLAPS 5 GEAR UP (VREF 30 + 40)	PITCH ATT	3.5	5.5	7.0	7.0	6.5
	%N1	48.8	54.0	59.7	64.7	69.0
	KIAS	177	177	185	203	223
FLAPS 15 GEAR UP (VREF 30 + 20)	PITCH ATT	3.5	6.5	8.0	7.5	7.0
	%N1	49.0	55.2	61.9	66.8	71.2
	KIAS	157	157	165	183	203
FLAPS 20 GEAR DOWN (VREF 30 + 20)	PITCH ATT	2.0	4.5	6.5	6.0	5.5
	%N1	56.2	61.4	67.3	73.1	78.1
	KIAS	157	157	165	183	203

Final Approach (1500 FT)

Gear Down, %N1 for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		150	200	250	300	350
FLAPS 20 (VREF 20 + 10)	PITCH ATT	0.0	2.0	2.0	2.5	2.5
	%N1	36.8	40.7	45.1	49.3	52.6
	KIAS	147	155	172	187	201
FLAPS 25 (VREF 25 + 10)	PITCH ATT	1.0	2.0	2.0	2.5	2.5
	%N1	51.5	49.8	54.7	59.2	63.3
	KIAS	147	147	163	178	191
FLAPS 30 (VREF 30 + 10)	PITCH ATT	0.0	1.0	2.0	1.5	
	%N1	56.9	55.6	60.2	65.3	
	KIAS	147	147	155	172	

Performance Inflight**Chapter PI****All Engine****Section 41****Long Range Cruise Maximum Operating Altitude****Max Climb Thrust****ISA + 10°C and Below**

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30(39°)	1.40(44°)	1.50(48°)
360	27300	5	30400	28800	27200
350	27900	4	31000	29400	27800
340	28500	3	31700	30000	28500
330	29200	1	32200	30500	29000
320	29900	0	32700	31000	29500
310	30600	-2	33200	31600	30000
300	31300	-4	33700	32100	30600
290	32000	-5	34300	32700	31200
280	32800	-7	34900	33300	31800
270	33600	-9	35500	33900	32400
260	34400	-11	36100	34500	33100
250	35200	-12	36800	35200	33800
240	36000	-14	37500	35900	34500
230	36900	-15	38200	36600	35200
220	37800	-15	39000	37400	36000
210	38800	-15	39800	38200	36800
200	39800	-15	40600	39000	37700
190	40900	-15	41500	39900	38600
180	42000	-15	42500	40900	39600
170	43100	-15	43100	42100	40800
160	43100	-15	43100	43100	42000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27300	11	30400	28800	27200
350	27900	10	31000	29400	27800
340	28500	8	31700	30000	28500
330	29200	7	32200	30500	29000
320	29900	5	32700	31000	29500
310	30600	4	33200	31600	30000
300	31300	2	33700	32100	30600
290	32000	0	34300	32700	31200
280	32800	-1	34900	33300	31800
270	33600	-3	35500	33900	32400
260	34400	-5	36100	34500	33100
250	35200	-7	36800	35200	33800
240	36000	-9	37500	35900	34500
230	36900	-9	38200	36600	35200
220	37800	-9	39000	37400	36000
210	38800	-9	39800	38200	36800
200	39800	-9	40600	39000	37700
190	40900	-9	41500	39900	38600
180	42000	-9	42500	40900	39600
170	43100	-9	43100	42100	40800
160	43100	-9	43100	43100	42000

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27300	17	30400	28800	27200
350	27900	15	31000	29400	27800
340	28500	14	31700	30000	28500
330	29200	12	32200	30500	29000
320	29900	11	32700	31000	29500
310	30600	9	33200	31600	30000
300	31300	8	33700	32100	30600
290	32000	6	34300	32700	31200
280	32800	4	34900	33300	31800
270	33600	3	35500	33900	32400
260	34400	1	36100	34500	33100
250	35200	-1	36800	35200	33800
240	36000	-3	37500	35900	34500
230	36900	-3	38200	36600	35200
220	37800	-3	39000	37400	36000
210	38800	-3	39800	38200	36800
200	39800	-3	40600	39000	37700
190	40900	-3	41500	39900	38600
180	42000	-3	42500	40900	39600
170	43100	-3	43100	42100	40800
160	43100	-3	43100	43100	42000

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		25	27	29	31	33	35	37	39	41	43
360	%N1	84.0	86.0	87.6	90.1						
	MACH	.819	.840	.837	.830						
	KIAS	346	342	326	310						
	FF/ENG	5139	5211	5162	5303						
340	%N1	83.0	84.7	86.1	88.1						
	MACH	.819	.839	.840	.835						
	KIAS	346	341	328	312						
	FF/ENG	4943	4959	4875	4910						
320	%N1	81.9	83.1	84.6	86.0	88.3					
	MACH	.818	.833	.840	.839	.833					
	KIAS	346	339	327	313	297					
	FF/ENG	4735	4662	4585	4523	4633					
300	%N1	80.2	81.8	82.9	84.5	86.1					
	MACH	.800	.823	.836	.840	.837					
	KIAS	337	334	326	314	299					
	FF/ENG	4416	4391	4316	4248	4232					
280	%N1	78.4	80.1	81.6	82.9	84.4	86.2				
	MACH	.775	.806	.827	.838	.840	.836				
	KIAS	326	326	322	313	300	285				
	FF/ENG	4088	4112	4069	4004	3948	3972				
260	%N1	76.6	78.3	80.0	81.3	82.8	84.2	86.6			
	MACH	.746	.780	.810	.830	.839	.839	.834			
	KIAS	313	315	315	309	300	287	272			
	FF/ENG	3751	3796	3803	3758	3703	3653	3726			
240	%N1	74.7	76.3	78.0	79.7	81.0	82.5	84.3			
	MACH	.720	.749	.783	.813	.831	.839	.839			
	KIAS	302	302	303	303	297	287	274			
	FF/ENG	3448	3464	3501	3503	3460	3406	3378			
220	%N1	73.1	74.2	75.8	77.6	79.3	80.6	82.5	84.7		
	MACH	.701	.721	.750	.785	.815	.832	.840	.838		
	KIAS	293	289	289	291	290	284	274	261		
	FF/ENG	3203	3158	3175	3207	3211	3165	3130	3132		
200	%N1	71.1	72.5	73.6	75.2	77.0	78.8	80.4	82.7	84.9	
	MACH	.680	.700	.719	.748	.784	.814	.832	.840	.838	
	KIAS	284	280	277	276	278	277	271	262	249	
	FF/ENG	2958	2915	2872	2886	2917	2918	2888	2878	2879	
180	%N1	68.6	70.2	71.7	72.8	74.4	76.2	78.4	80.4	82.7	84.8
	MACH	.648	.675	.697	.715	.744	.780	.812	.831	.839	.839
	KIAS	270	270	267	263	263	264	264	259	250	238
	FF/ENG	2673	2665	2631	2592	2599	2622	2636	2634	2624	2609
160	%N1	65.8	67.4	69.1	70.7	71.9	73.3	75.5	78.1	80.2	82.5
	MACH	.612	.639	.667	.691	.710	.735	.772	.806	.828	.838
	KIAS	254	254	255	253	250	248	249	250	246	238
	FF/ENG	2392	2386	2375	2356	2321	2308	2335	2372	2379	2356

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitude
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
282	261	242	226	213	200	191	182	174	167	160
559	519	482	451	424	400	382	366	351	337	325
837	777	723	677	637	600	574	550	528	508	489
1115	1035	964	902	849	800	766	734	705	678	653
1395	1295	1206	1129	1061	1000	957	918	881	848	817
1675	1555	1447	1354	1273	1200	1149	1101	1057	1017	980
1956	1815	1689	1581	1486	1400	1340	1285	1234	1187	1144
2237	2075	1931	1807	1698	1600	1532	1469	1410	1356	1307
2520	2338	2174	2034	1911	1800	1723	1652	1586	1525	1470
2803	2599	2417	2260	2124	2000	1915	1835	1762	1695	1633

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	3.8	0:38	3.3	0:37	2.8	0:35	2.5	0:35	2.2	0:34
400	7.9	1:11	7.2	1:09	6.3	1:04	5.7	1:02	5.3	1:00
600	11.9	1:45	11.0	1:40	9.8	1:33	9.0	1:30	8.4	1:26
800	15.9	2:19	14.8	2:13	13.2	2:02	12.2	1:58	11.5	1:52
1000	19.9	2:53	18.6	2:45	16.6	2:31	15.4	2:26	14.5	2:19
1200	23.8	3:27	22.3	3:17	20.0	3:01	18.6	2:54	17.5	2:45
1400	27.8	4:02	26.0	3:50	23.4	3:31	21.8	3:23	20.5	3:12
1600	31.6	4:37	29.7	4:23	26.8	4:01	24.9	3:51	23.5	3:39
1800	35.5	5:12	33.3	4:56	30.1	4:31	28.1	4:19	26.5	4:06
2000	39.3	5:47	36.9	5:30	33.4	5:01	31.2	4:48	29.4	4:33

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	150	200	250	300	350
5	-0.7	-0.4	0.0	0.4	1.1
10	-1.6	-0.8	0.0	1.1	2.5
15	-2.5	-1.3	0.0	1.7	3.9
20	-3.3	-1.7	0.0	2.3	5.2
25	-4.1	-2.2	0.0	2.9	6.5
30	-4.9	-2.6	0.0	3.6	7.8
35	-5.7	-3.1	0.0	4.2	9.0
40	-6.4	-3.5	0.0	4.8	10.2

Long Range Cruise Enroute Fuel and Time - High Altitude
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
649	613	580	551	524	500	479	459	441	424	409
1286	1217	1154	1098	1047	1000	959	921	886	853	823
1926	1824	1730	1646	1570	1500	1439	1383	1330	1282	1237
2569	2432	2307	2195	2094	2000	1920	1845	1775	1710	1651
3215	3043	2886	2745	2617	2500	2400	2306	2219	2139	2065
3864	3656	3466	3296	3142	3000	2880	2768	2664	2568	2479
4516	4271	4047	3847	3666	3500	3360	3229	3108	2996	2893
5170	4888	4630	4400	4192	4000	3840	3691	3552	3424	3306
5826	5506	5214	4953	4717	4500	4320	4152	3996	3852	3719
6485	6126	5798	5506	5242	5000	4800	4613	4440	4279	4132
7146	6748	6384	6061	5768	5500	5280	5074	4883	4706	4545
7809	7371	6972	6616	6295	6000	5759	5534	5326	5133	4956
8474	7996	7559	7171	6821	6500	6238	5994	5768	5558	5367
9144	8624	8149	7728	7348	7000	6717	6454	6209	5983	5776
9818	9255	8741	8286	7876	7500	7196	6912	6649	6406	6184
10496	9889	9335	8845	8404	8000	7674	7371	7089	6829	6591
11179	10526	9932	9406	8933	8500	8153	7829	7528	7251	6997
11866	11167	10530	9968	9462	9000	8631	8286	7966	7671	7401
12559	11811	11131	10531	9993	9500	9108	8742	8403	8090	7804
13256	12459	11735	11096	10523	10000	9585	9198	8839	8508	8206

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
500	6.9	1:10	6.7	1:10	6.5	1:10	6.4	1:10	6.4	1:11
1000	14.3	2:17	13.8	2:13	13.5	2:12	13.2	2:12	13.2	2:13
1500	21.6	3:23	21.0	3:17	20.4	3:15	20.1	3:14	20.0	3:15
2000	29.0	4:29	28.2	4:21	27.4	4:17	26.9	4:17	26.8	4:18
2500	36.0	5:37	35.1	5:27	34.2	5:21	33.5	5:19	33.2	5:20
3000	43.1	6:46	42.0	6:33	40.9	6:25	40.0	6:22	39.7	6:22
3500	49.9	7:56	48.6	7:41	47.4	7:30	46.3	7:25	45.8	7:25
4000	56.7	9:06	55.2	8:49	53.8	8:35	52.7	8:29	52.0	8:27
4500	63.2	10:18	61.6	9:59	60.1	9:42	58.7	9:34	57.9	9:31
5000	69.7	11:30	68.0	11:09	66.3	10:50	64.8	10:38	63.9	10:34
5500	76.0	12:44	74.1	12:21	72.3	11:59	70.7	11:45	69.6	11:38
6000	82.3	13:57	80.2	13:32	78.3	13:09	76.5	12:52	75.3	12:42
6500	88.4	15:13	86.1	14:46	84.1	14:21	82.1	14:01	80.7	13:48
7000	94.5	16:28	92.0	15:59	89.8	15:32	87.8	15:10	86.2	14:54
7500	100.4	17:46	97.7	17:14	95.4	16:46	93.2	16:21	91.5	16:02
8000	106.2	19:05	103.4	18:30	100.9	17:59	98.6	17:32	96.8	17:10
8500	112.0	20:26	109.0	19:47	106.3	19:14	103.8	18:45	101.9	18:20
9000	117.7	21:48	114.5	21:05	111.7	20:29	109.0	19:58	106.9	19:30
9500	123.3	23:12	119.9	22:26	116.9	21:46	114.1	21:13	111.8	20:43
10000	129.0	24:37	125.3	23:47	122.0	23:03	119.1	22:28	116.7	21:55

**Long Range Cruise Enroute Fuel and Time - High Altitude
Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	150	200	250	300	350
10	-2.3	-1.2	0.0	3.2	13.1
20	-4.4	-2.4	0.0	5.4	18.3
30	-6.5	-3.6	0.0	7.4	23.1
40	-8.6	-4.8	0.0	9.3	27.5
50	-10.8	-5.9	0.0	11.1	31.4
60	-13.0	-7.0	0.0	12.7	35.0
70	-15.2	-8.1	0.0	14.2	38.1
80	-17.5	-9.2	0.0	15.6	40.9
90	-19.8	-10.3	0.0	16.8	43.2
100	-22.1	-11.3	0.0	18.0	45.1
110	-24.4	-12.3	0.0	19.0	46.6
120	-26.8	-13.3	0.0	19.8	47.7
130	-29.2	-14.3	0.0	20.6	48.4

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)										
	360	340	320	300	280	260	240	220	200	180	160
43							120	55	17	1	3
41						105	50	17	2	1	12
39					87	43	15	2	1	10	25
37			119	68	33	11	1	1	9	22	40
35		89	50	24	8	1	1	9	21	36	54
33	64	35	15	4	0	2	9	21	35	50	67
31	22	9	2	0	4	11	21	34	49	64	79
29	4	0	1	5	13	23	35	48	62	76	89
27	0	3	8	16	25	36	48	61	74	86	97
25	5	11	19	28	38	50	61	73	84	94	104

The above wind factor table is for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. Read wind factors for present and new altitudes from table.
2. Determine difference (new altitude wind factor minus present altitude wind factor);
This difference may be negative or positive.
3. Break-even wind at new altitude is present altitude wind plus difference from step 2.

Descent at .84M/310/250

PRESSURE ALTITUDE (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	96	103	110	117	123	128	133	139	145	150
TIME (MINUTES)	20	21	22	23	24	24	25	26	26	27

**Holding
Flaps Up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
360	%N1	62.0	64.9	69.0	73.3	78.3	83.1	88.2			
	KIAS	264	264	265	269	308	312	310			
	FF/ENG	4660	4620	4570	4590	4840	5020	5300			
340	%N1	60.5	63.4	67.5	71.7	76.7	81.6	86.4			
	KIAS	260	260	260	260	299	302	307			
	FF/ENG	4410	4360	4310	4310	4540	4680	4890			
320	%N1	58.8	61.5	65.7	69.8	74.9	79.6	84.4	91.3		
	KIAS	253	253	253	253	289	293	297	278		
	FF/ENG	4130	4080	4030	4020	4210	4320	4480	4980		
300	%N1	57.2	59.7	63.9	67.9	72.6	77.6	82.3	88.0		
	KIAS	244	244	244	244	259	283	287	278		
	FF/ENG	3860	3810	3760	3740	3800	3990	4130	4430		
280	%N1	55.6	58.0	62.1	66.1	70.7	75.7	80.5	85.6		
	KIAS	238	238	238	238	238	272	276	278		
	FF/ENG	3630	3570	3510	3480	3500	3690	3810	4030		
260	%N1	53.9	56.3	60.1	64.3	68.6	73.7	78.5	83.5	93.7	
	KIAS	229	229	229	229	229	262	265	269	247	
	FF/ENG	3390	3330	3270	3230	3240	3400	3500	3630	4260	
240	%N1	52.2	54.5	58.2	62.3	66.5	71.1	76.2	81.2	88.6	
	KIAS	223	223	223	223	223	228	254	258	247	
	FF/ENG	3180	3110	3030	2990	2990	3010	3190	3290	3640	
220	%N1	50.4	52.7	56.2	60.1	64.3	68.7	73.9	78.9	85.6	92.1
	KIAS	217	217	217	217	217	217	242	246	247	231
	FF/ENG	2970	2890	2800	2760	2740	2740	2890	2980	3220	3530
200	%N1	48.4	50.9	54.4	58.0	62.2	66.3	71.3	76.3	82.8	87.4
	KIAS	217	217	217	217	217	217	226	233	237	231
	FF/ENG	2790	2710	2610	2570	2530	2520	2570	2670	2830	3010
180	%N1	46.6	49.1	52.7	56.2	60.1	64.3	68.7	73.4	79.9	84.1
	KIAS	217	217	217	217	217	217	217	220	223	226
	FF/ENG	2630	2550	2450	2400	2360	2380	2320	2370	2500	2610
160	%N1	45.1	47.4	51.0	54.5	58.2	62.3	66.5	71.0	77.1	81.1
	KIAS	217	217	217	217	217	217	217	217	217	217
	FF/ENG	2560	2470	2370	2300	2250	2220	2170	2160	2230	2280

This table includes 5% additional fuel for holding in a racetrack pattern.

**Holding
Flaps 1**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
360	%N1	64.8	67.6	72.3	76.7	81.7
	KIAS	244	244	244	244	244
	FF/ENG	5150	5130	5110	5150	5270
340	%N1	63.2	66.0	70.3	74.9	79.9
	KIAS	240	240	240	240	240
	FF/ENG	4840	4810	4790	4810	4920
320	%N1	61.5	64.4	68.5	73.1	78.0
	KIAS	233	233	233	233	233
	FF/ENG	4540	4510	4480	4490	4580
300	%N1	59.7	62.6	66.6	71.3	76.1
	KIAS	224	224	224	224	224
	FF/ENG	4250	4220	4190	4190	4260
280	%N1	57.9	60.6	64.7	69.1	74.0
	KIAS	218	218	218	218	218
	FF/ENG	3970	3930	3890	3880	3930
260	%N1	56.1	58.6	62.8	66.9	71.8
	KIAS	209	209	209	209	209
	FF/ENG	3700	3650	3600	3600	3620
240	%N1	54.2	56.6	60.6	64.6	69.4
	KIAS	203	203	203	203	203
	FF/ENG	3430	3370	3310	3300	3310
220	%N1	52.1	54.5	58.2	62.3	66.7
	KIAS	197	197	197	197	197
	FF/ENG	3170	3100	3030	3010	3010
200	%N1	50.1	52.3	55.9	59.8	64.0
	KIAS	197	197	197	197	197
	FF/ENG	2940	2860	2770	2730	2720
180	%N1	47.9	50.3	53.8	57.4	61.6
	KIAS	197	197	197	197	197
	FF/ENG	2740	2650	2550	2510	2480
160	%N1	45.9	48.4	51.8	55.2	59.2
	KIAS	197	197	197	197	197
	FF/ENG	2630	2540	2430	2380	2330

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight

Advisory Information

Chapter PI

Section 42

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 30

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LANDING WT	PER 5000 KG ABOVE / BELOW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN / UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF30	ONE REV	NO REV

Dry Runway

MAX MANUAL	990	+25/-5	20	-40/+130	+10/-10	+20/-20	35	20	45
AUTOBRAKE MAX	1335	+25/-5	35	-55/+190	0/0	+35/-35	65	0	0
AUTOBRAKE 4	1740	+40/-5	45	-80/+270	0/0	+45/-50	95	0	0
AUTOBRAKE 3	2065	+45/-15	60	-100/+335	0/-5	+60/-60	115	0	0
AUTOBRAKE 2	2315	+50/-25	70	-115/+390	+20/-50	+65/-65	90	45	45
AUTOBRAKE 1	2530	+60/-30	85	-130/+455	+75/-80	+75/-75	90	245	285

Good Reported Braking Action

MAX MANUAL	1620	+35/-10	45	-75/+265	+40/-35	+40/-40	65	100	230
AUTOBRAKE MAX	1680	+35/-10	45	-80/+270	+35/-30	+40/-40	70	105	245
AUTOBRAKE 4	2010	+45/-5	60	-90/+315	+10/-5	+60/-60	110	5	40
AUTOBRAKE 3	2375	+50/-15	70	-115/+385	0/-5	+70/-70	130	0	0
AUTOBRAKE 2	2660	+60/-30	80	-130/+450	+25/-60	+75/-75	105	50	50
AUTOBRAKE 1	2910	+70/-35	100	-150/+525	+85/-90	+85/-85	105	280	330

Medium Reported Braking Action

MAX MANUAL	2195	+45/-25	70	-120/+430	+100/-80	+60/-60	80	265	690
AUTOBRAKE MAX	2200	+45/-25	70	-120/+430	+105/-80	+60/-60	80	265	690
AUTOBRAKE 4	2260	+50/-10	70	-120/+435	+85/-50	+65/-65	110	255	690
AUTOBRAKE 3	2505	+60/-15	75	-130/+470	+50/-40	+75/-75	130	115	475
AUTOBRAKE 2	2730	+60/-30	85	-145/+500	+70/-80	+75/-80	105	115	350
AUTOBRAKE 1	2920	+70/-35	100	-155/+535	+115/-100	+85/-85	105	305	455

Poor Reported Braking Action

MAX MANUAL	2825	+65/-35	100	-180/+665	+230/-155	+80/-80	90	550	1650
AUTOBRAKE MAX	2835	+65/-35	105	-180/+665	+230/-155	+80/-80	90	560	1655
AUTOBRAKE 4	2835	+65/-30	105	-180/+665	+230/-150	+80/-80	100	560	1655
AUTOBRAKE 3	2900	+70/-30	100	-180/+680	+200/-120	+85/-85	125	520	1620
AUTOBRAKE 2	3040	+70/-35	105	-185/+690	+195/-150	+85/-85	105	425	1505
AUTOBRAKE 1	3150	+75/-40	110	-190/+715	+225/-160	+90/-90	105	525	1430

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 75 m.

For autobrake and manual speedbrakes, increase reference landing distance by 60 m.

Distances for GOOD, MEDIUM, and POOR are increased by 15%.

Includes distance from 50 ft above threshold (305 meters of unfactored air distance).

ADVISORY INFORMATION**Normal Configuration Landing Distance****Flaps 25**

	LANDING DISTANCE AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	260000 KG LANDING WT	PER 5000 KG ABOVE/ BELOW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN / UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF25	ONE REV NO REV

Dry Runway

MAX MANUAL	1045	+25/-10	25	-40/+135	+15/-10	+25/-25	35	25	50
AUTOBRAKE MAX	1445	+20/-10	35	-60/+195	0/0	+35/-35	70	0	0
AUTOBRAKE 4	1900	+30/-15	50	-85/+285	0/0	+55/-55	100	0	0
AUTOBRAKE 3	2265	+35/-25	65	-105/+350	0/-15	+65/-65	110	0	0
AUTOBRAKE 2	2510	+40/-35	80	-120/+405	+30/-60	+70/-70	90	80	80
AUTOBRAKE 1	2735	+50/-40	95	-140/+470	+85/-90	+80/-80	90	295	370

Good Reported Braking Action

MAX MANUAL	1725	+25/-15	45	-80/+275	+45/-40	+45/-45	65	110	265
AUTOBRAKE MAX	1800	+30/-15	50	-80/+280	+40/-30	+45/-45	75	115	280
AUTOBRAKE 4	2195	+35/-15	65	-100/+335	+10/-5	+65/-65	115	5	45
AUTOBRAKE 3	2605	+40/-30	75	-120/+400	0/-15	+75/-75	125	0	0
AUTOBRAKE 2	2885	+45/-40	90	-140/+465	+35/-70	+80/-80	105	90	90
AUTOBRAKE 1	3145	+60/-45	110	-160/+540	+100/-105	+90/-90	105	340	425

Medium Reported Braking Action

MAX MANUAL	2350	+40/-30	75	-120/+450	+105/-85	+65/-65	80	295	775
AUTOBRAKE MAX	2350	+40/-30	75	-125/+450	+110/-80	+65/-65	85	295	775
AUTOBRAKE 4	2450	+40/-25	75	-125/+455	+80/-50	+70/-70	115	260	755
AUTOBRAKE 3	2735	+40/-30	80	-140/+490	+50/-50	+80/-80	125	115	500
AUTOBRAKE 2	2955	+50/-40	90	-150/+520	+80/-90	+85/-85	105	155	410
AUTOBRAKE 1	3155	+60/-45	110	-160/+560	+125/-110	+90/-90	105	360	560

Poor Reported Braking Action

MAX MANUAL	3020	+60/-40	110	-185/+685	+235/-160	+85/-85	90	615	1855
AUTOBRAKE MAX	3030	+60/-40	110	-185/+685	+240/-165	+85/-85	90	615	1865
AUTOBRAKE 4	3030	+60/-40	110	-185/+685	+240/-155	+85/-85	105	620	1865
AUTOBRAKE 3	3140	+60/-40	110	-185/+695	+200/-130	+90/-90	125	540	1795
AUTOBRAKE 2	3275	+60/-45	115	-190/+715	+215/-160	+100/-100	105	490	1680
AUTOBRAKE 1	3390	+65/-50	120	-195/+730	+240/-175	+100/-100	105	590	1620

Reference distance is for sea level, standard day, no wind or slope, VREF25 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 80 m.

For autobrake and manual speedbrakes, increase reference landing distance by 65 m.

Distances for GOOD, MEDIUM, and POOR are increased by 15%.

Includes distance from 50 ft above threshold (305 meters of unfactored air distance).

ADVISORY INFORMATION**Normal Configuration Landing Distance****Flaps 20**

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LANDING WT	PER 5000 KG ABOVE / BELOW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN / UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF20	ONE REV	NO REV

Dry Runway

MAX MANUAL	1120	+30/-10	25	-40/+140	+15/-15	+25/-25	40	25	60
AUTOBRAKE MAX	1570	+20/-20	40	-60/+205	0/0	+40/-40	75	0	0
AUTOBRAKE 4	2080	+30/-25	60	-90/+295	0/0	+60/-60	105	0	0
AUTOBRAKE 3	2480	+40/-35	70	-110/+370	0/-15	+75/-75	120	0	0
AUTOBRAKE 2	2760	+45/-45	90	-125/+425	+35/-60	+80/-80	100	95	95
AUTOBRAKE 1	3010	+55/-50	105	-145/+495	+90/-100	+90/-90	100	350	425

Good Reported Braking Action

MAX MANUAL	1870	+30/-25	50	-80/+290	+45/-40	+45/-45	65	130	310
AUTOBRAKE MAX	1945	+30/-25	60	-85/+295	+40/-30	+50/-50	80	140	330
AUTOBRAKE 4	2400	+35/-30	70	-105/+350	+10/0	+70/-70	120	10	50
AUTOBRAKE 3	2850	+45/-40	80	-125/+425	0/-15	+85/-85	140	0	0
AUTOBRAKE 2	3175	+50/-50	105	-145/+490	+40/-70	+90/-90	115	110	110
AUTOBRAKE 1	3460	+65/-60	120	-165/+570	+105/-115	+105/-105	115	400	490

Medium Reported Braking Action

MAX MANUAL	2560	+45/-40	85	-130/+465	+115/-90	+70/-70	85	345	920
AUTOBRAKE MAX	2560	+45/-40	85	-130/+465	+120/-90	+75/-75	85	345	915
AUTOBRAKE 4	2660	+45/-35	85	-130/+475	+85/-60	+75/-75	120	300	885
AUTOBRAKE 3	2990	+45/-45	90	-145/+510	+60/-50	+85/-85	140	130	590
AUTOBRAKE 2	3245	+60/-50	105	-155/+545	+85/-100	+100/-100	115	180	475
AUTOBRAKE 1	3475	+65/-60	120	-175/+585	+130/-120	+105/-105	115	430	640

Poor Reported Braking Action

MAX MANUAL	3300	+65/-50	120	-190/+715	+260/-180	+100/-100	100	720	2200
AUTOBRAKE MAX	3305	+65/-50	120	-190/+715	+265/-180	+100/-100	100	720	2200
AUTOBRAKE 4	3305	+65/-50	120	-190/+715	+265/-165	+100/-100	105	720	2200
AUTOBRAKE 3	3425	+65/-50	120	-195/+725	+220/-140	+105/-105	130	625	2120
AUTOBRAKE 2	3580	+65/-60	125	-200/+740	+225/-175	+110/-110	115	565	1995
AUTOBRAKE 1	3720	+70/-65	140	-205/+765	+260/-190	+110/-110	110	690	1910

Reference distance is for sea level, standard day, no wind or slope, VREF20 approach speed, 2 engine reverse thrust, and auto speedbrakes.

For Max Manual braking and manual speedbrakes, increase reference landing distance by 85 m.

For autobrake and manual speedbrakes, increase reference landing distance by 70 m.

Distances for GOOD, MEDIUM, and POOR are increased by 15%.

Includes distance from 50 ft above threshold (305 meters of unfactored air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****ANTISKID - Flaps 25****VREF25**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	2045	+35/-25	65	-105/+390	+90/-75	+55/-55	70	255	675
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	2045	+35/-25	65	-105/+390	+90/-75	+55/-55	70	255	675
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	2625	+50/-35	95	-160/+595	+205/-140	+75/-75	80	535	1615
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	3565	+75/-60	140	-265/+1110	+1265/-315	+110/-110	90	1435	5000
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

ANTISKID - Flaps 30

VREF30

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1910	+40/-20	60	-105/+375	+85/-70	+50/-50	70	230	600
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	1910	+40/-20	60	-105/+375	+85/-70	+50/-50	70	230	600
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	2455	+55/-30	85	-155/+580	+200/-135	+70/-70	80	480	1435
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	3345	+80/-45	130	-255/+1090	+1220/-305	+100/-100	90	1320	5000
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

ENG SHUTDOWN L, R - Flaps 20

VREF20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1130	+35/-10	25	-45/+145	+15/-15	+25/-25	40	0	30
AUTOBRAKE MAX	1570	+20/-20	40	-60/+205	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2840	+45/-40	85	-130/+435	+5/-20	+85/-85	140	0	0

Good Reported Braking Action

MAX MANUAL	1700	+25/-20	50	-75/+265	+50/-45	+45/-45	60	0	150
AUTOBRAKE MAX	1775	+25/-25	50	-80/+270	+45/-40	+50/-50	70	0	160
AUTOBRAKE 2	2840	+45/-40	85	-130/+435	+5/-20	+85/-85	140	0	0

Medium Reported Braking Action

MAX MANUAL	2445	+40/-35	80	-125/+445	+135/-105	+70/-70	85	0	460
AUTOBRAKE MAX	2450	+40/-35	80	-125/+445	+135/-95	+70/-70	95	0	455
AUTOBRAKE 3	2675	+45/-35	85	-135/+465	+90/-60	+80/-80	125	0	345

Poor Reported Braking Action

MAX MANUAL	3325	+60/-55	115	-195/+710	+330/-215	+100/-100	105	0	1125
AUTOBRAKE MAX	3330	+60/-55	120	-195/+710	+335/-215	+100/-100	105	0	1130
AUTOBRAKE 3	3365	+65/-55	120	-195/+715	+320/-205	+100/-105	110	0	1140

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

ENG SHUTDOWN L, R - Flaps 30

VREF30

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	995	+30/-5	20	-40/+135	+15/-10	+20/-20	40	0	25
AUTOBRAKE MAX	1335	+25/-5	35	-55/+190	0/0	+35/-35	65	0	0
AUTOBRAKE 2	2345	+55/-15	70	-115/+390	+10/-15	+70/-70	125	0	0

Good Reported Braking Action

MAX MANUAL	1460	+30/-10	40	-70/+245	+40/-35	+40/-40	60	0	110
AUTOBRAKE MAX	1525	+30/-10	40	-70/+250	+40/-35	+40/-40	65	0	120
AUTOBRAKE 2	2345	+55/-15	70	-115/+390	+10/-15	+70/-70	125	0	0

Medium Reported Braking Action

MAX MANUAL	2070	+45/-20	65	-115/+410	+110/-85	+60/-60	80	0	340
AUTOBRAKE MAX	2070	+45/-15	65	-115/+410	+115/-80	+60/-60	85	0	340
AUTOBRAKE 3	2235	+50/-15	70	-120/+425	+80/-55	+65/-65	110	0	270

Poor Reported Braking Action

MAX MANUAL	2790	+65/-30	95	-175/+655	+280/-180	+85/-85	95	0	825
AUTOBRAKE MAX	2795	+65/-30	95	-175/+655	+285/-180	+85/-85	95	0	830
AUTOBRAKE 3	2830	+65/-30	95	-175/+660	+270/-180	+85/-85	95	0	840

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****FLAP / SLAT CONTROL - Flaps 20****VREF20**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1120	+30/-10	25	-40/+140	+15/-15	+25/-25	40	25	60
AUTOBRAKE MAX	1570	+20/-20	40	-60/+205	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2760	+45/-45	90	-125/+425	+35/-60	+80/-80	100	95	95

Good Reported Braking Action

MAX MANUAL	1625	+25/-20	45	-70/+250	+40/-35	+40/-40	55	115	270
AUTOBRAKE MAX	1690	+25/-20	50	-75/+255	+35/-25	+45/-45	70	120	285
AUTOBRAKE 2	2760	+45/-45	90	-125/+425	+35/-60	+80/-80	100	95	95

Medium Reported Braking Action

MAX MANUAL	2225	+40/-35	75	-115/+405	+100/-80	+60/-60	75	300	800
AUTOBRAKE MAX	2225	+40/-35	75	-115/+405	+105/-80	+65/-65	75	300	795
AUTOBRAKE 3	2600	+40/-40	80	-125/+445	+50/-45	+75/-75	120	115	515

Poor Reported Braking Action

MAX MANUAL	2870	+55/-45	105	-165/+620	+225/-155	+85/-85	85	625	1915
AUTOBRAKE MAX	2875	+55/-45	105	-165/+620	+230/-155	+85/-85	85	625	1915
AUTOBRAKE 3	2980	+55/-45	105	-170/+630	+190/-120	+90/-90	115	545	1845

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****FLAPS DRIVE - (Flaps ≤ 5)****VREF30+40**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1300	+55/-10	45	-45/+205	+20/-15	+40/-35	55	55	130
AUTOBRAKE MAX	1910	+35/-5	50	-70/+230	0/0	+50/-50	80	0	0
AUTOBRAKE 2	3345	+70/-40	115	-140/+470	+60/-75	+100/-100	115	225	225

Good Reported Braking Action

MAX MANUAL	1850	+30/-15	55	-75/+265	+45/-40	+50/-50	55	155	375
AUTOBRAKE MAX	1995	+35/-5	55	-80/+275	+20/-15	+55/-55	80	95	330
AUTOBRAKE 2	3345	+70/-40	115	-140/+470	+60/-75	+100/-100	115	225	225

Medium Reported Braking Action

MAX MANUAL	2570	+50/-25	90	-120/+425	+110/-90	+75/-75	75	415	1170
AUTOBRAKE MAX	2570	+50/-25	90	-120/+425	+110/-80	+75/-75	80	410	1160
AUTOBRAKE 3	3160	+60/-30	100	-140/+485	+60/-60	+95/-95	120	150	690

Poor Reported Braking Action

MAX MANUAL	3335	+70/-40	130	-175/+655	+245/-170	+100/-100	90	870	2925
AUTOBRAKE MAX	3335	+70/-40	130	-175/+655	+245/-170	+100/-100	90	870	2925
AUTOBRAKE 3	3530	+75/-40	130	-185/+670	+215/-140	+105/-110	120	690	2750

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

FLAPS DRIVE - (5 < Flaps < 20)

VREF30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1135	+40/-5	25	-40/+145	+15/-15	+25/-25	40	30	65
AUTOBRAKE MAX	1605	+30/-5	40	-65/+210	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2845	+60/-30	90	-130/+435	+35/-50	+85/-85	115	85	85

Good Reported Braking Action

MAX MANUAL	1660	+30/-10	50	-75/+250	+40/-35	+45/-45	60	125	305
AUTOBRAKE MAX	1715	+35/-5	50	-75/+255	+35/-25	+45/-45	70	125	315
AUTOBRAKE 2	2845	+60/-30	90	-130/+435	+35/-50	+85/-85	115	85	85

Medium Reported Braking Action

MAX MANUAL	2290	+50/-20	75	-115/+410	+105/-85	+65/-65	75	340	930
AUTOBRAKE MAX	2290	+50/-20	75	-115/+410	+105/-85	+65/-65	75	335	925
AUTOBRAKE 3	2665	+55/-20	80	-130/+450	+50/-45	+80/-80	125	120	625

Poor Reported Braking Action

MAX MANUAL	2965	+65/-35	110	-170/+630	+230/-160	+85/-85	90	710	2280
AUTOBRAKE MAX	2970	+65/-35	110	-170/+630	+235/-160	+90/-90	90	710	2285
AUTOBRAKE 3	3055	+70/-30	110	-170/+640	+210/-125	+90/-90	120	630	2205

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****FLAPS DRIVE - (Flaps $\geq$ 20)****VREF20**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1120	+30/-10	25	-40/+140	+15/-15	+25/-25	40	25	60
AUTOBRAKE MAX	1570	+20/-20	40	-60/+205	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2760	+45/-45	90	-125/+425	+35/-60	+80/-80	100	95	95

Good Reported Braking Action

MAX MANUAL	1625	+25/-20	45	-70/+250	+40/-35	+40/-40	55	115	270
AUTOBRAKE MAX	1690	+25/-20	50	-75/+255	+35/-25	+45/-45	70	120	285
AUTOBRAKE 2	2760	+45/-45	90	-125/+425	+35/-60	+80/-80	100	95	95

Medium Reported Braking Action

MAX MANUAL	2225	+40/-35	75	-115/+405	+100/-80	+60/-60	75	300	800
AUTOBRAKE MAX	2225	+40/-35	75	-115/+405	+105/-80	+65/-65	75	300	795
AUTOBRAKE 3	2600	+40/-40	80	-125/+445	+50/-45	+75/-75	120	115	515

Poor Reported Braking Action

MAX MANUAL	2870	+55/-45	105	-165/+620	+225/-155	+85/-85	85	625	1915
AUTOBRAKE MAX	2875	+55/-45	105	-165/+620	+230/-155	+85/-85	85	625	1915
AUTOBRAKE 3	2980	+55/-45	105	-170/+630	+190/-120	+90/-90	115	545	1845

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****FLAPS PRIMARY FAIL - Flaps 20****VREF20**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1280	+30/-15	30	-45/+155	+15/-15	+30/-30	50	35	80
AUTOBRAKE MAX	1570	+20/-20	40	-60/+205	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2825	+45/-45	85	-130/+430	+15/-35	+85/-85	125	30	30

Good Reported Braking Action

MAX MANUAL	1820	+25/-25	50	-80/+270	+50/-45	+45/-45	70	140	340
AUTOBRAKE MAX	1820	+25/-25	55	-80/+270	+50/-40	+50/-50	75	140	335
AUTOBRAKE 2	2825	+45/-45	85	-130/+430	+15/-35	+85/-85	125	30	30

Medium Reported Braking Action

MAX MANUAL	2445	+40/-35	80	-120/+430	+115/-90	+70/-70	85	360	985
AUTOBRAKE MAX	2445	+40/-35	80	-120/+425	+120/-95	+70/-70	85	360	975
AUTOBRAKE 3	2640	+40/-35	80	-130/+450	+70/-45	+80/-80	130	180	795

Poor Reported Braking Action

MAX MANUAL	3110	+60/-50	115	-175/+650	+250/-170	+90/-90	100	725	2315
AUTOBRAKE MAX	3110	+60/-50	115	-175/+650	+255/-175	+90/-90	100	725	2315
AUTOBRAKE 3	3135	+60/-50	115	-175/+650	+245/-150	+95/-95	115	700	2285

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****FLIGHT CONTROL MODE - Flaps 20****VREF20**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1295	+30/-15	30	-50/+160	+20/-15	+30/-30	50	35	85
AUTOBRAKE MAX	1570	+20/-20	40	-60/+205	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2845	+45/-45	85	-130/+435	+5/-30	+85/-85	135	10	10

Good Reported Braking Action

MAX MANUAL	1850	+30/-25	55	-80/+275	+50/-45	+50/-50	75	150	365
AUTOBRAKE MAX	1850	+30/-25	55	-80/+270	+50/-45	+50/-50	75	145	355
AUTOBRAKE 2	2845	+45/-45	85	-130/+435	+5/-30	+85/-85	135	10	10

Medium Reported Braking Action

MAX MANUAL	2495	+45/-35	85	-125/+435	+120/-95	+70/-70	90	385	1060
AUTOBRAKE MAX	2495	+45/-35	85	-120/+435	+125/-100	+70/-70	90	380	1050
AUTOBRAKE 3	2650	+40/-35	80	-130/+450	+80/-45	+80/-80	130	225	895

Poor Reported Braking Action

MAX MANUAL	3180	+60/-50	120	-180/+655	+260/-175	+95/-95	105	775	2515
AUTOBRAKE MAX	3180	+60/-50	120	-180/+655	+265/-185	+95/-95	105	775	2515
AUTOBRAKE 3	3195	+60/-50	120	-180/+660	+260/-160	+95/-95	115	760	2500

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS C - Flaps 20****VREF20**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1280	+30/-15	30	-45/+155	+15/-15	+30/-30	50	35	80
AUTOBRAKE MAX	1570	+20/-20	40	-60/+205	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2825	+45/-45	85	-130/+430	+15/-35	+85/-85	125	30	30

Good Reported Braking Action

MAX MANUAL	1820	+25/-25	50	-80/+270	+50/-45	+45/-45	70	140	340
AUTOBRAKE MAX	1820	+25/-25	55	-80/+270	+50/-40	+50/-50	75	140	335
AUTOBRAKE 2	2825	+45/-45	85	-130/+430	+15/-35	+85/-85	125	30	30

Medium Reported Braking Action

MAX MANUAL	2445	+40/-35	80	-120/+430	+115/-90	+70/-70	85	360	985
AUTOBRAKE MAX	2445	+40/-35	80	-120/+425	+120/-95	+70/-70	85	360	975
AUTOBRAKE 3	2640	+40/-35	80	-130/+450	+70/-45	+80/-80	130	180	795

Poor Reported Braking Action

MAX MANUAL	3110	+60/-50	115	-175/+650	+250/-170	+90/-90	100	725	2315
AUTOBRAKE MAX	3110	+60/-50	115	-175/+650	+255/-175	+90/-90	100	725	2315
AUTOBRAKE 3	3135	+60/-50	115	-175/+650	+245/-150	+95/-95	115	700	2285

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS L - Flaps 25****VREF25**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1125	+25/-10	25	-45/+150	+15/-15	+25/-25	45	0	35
AUTOBRAKE MAX	1445	+20/-10	35	-60/+195	0/0	+35/-35	70	0	0
AUTOBRAKE 2	2595	+40/-25	75	-125/+415	0/0	+75/-75	145	0	0

Good Reported Braking Action

MAX MANUAL	1700	+25/-15	50	-80/+270	+55/-45	+45/-45	70	0	160
AUTOBRAKE MAX	1740	+25/-15	50	-80/+275	+50/-40	+45/-45	75	0	165
AUTOBRAKE 2	2595	+40/-25	75	-125/+415	0/0	+75/-75	145	0	0

Medium Reported Braking Action

MAX MANUAL	2460	+40/-30	80	-130/+465	+150/-115	+70/-70	90	0	510
AUTOBRAKE MAX	2465	+40/-30	80	-130/+465	+155/-115	+70/-70	95	0	510
AUTOBRAKE 3	2530	+40/-25	80	-135/+470	+130/-70	+75/-75	125	0	500

Poor Reported Braking Action

MAX MANUAL	3395	+60/-45	120	-210/+780	+400/-245	+105/-105	110	0	1310
AUTOBRAKE MAX	3405	+60/-45	125	-210/+780	+405/-245	+105/-105	110	0	1310
AUTOBRAKE 3	3405	+60/-45	125	-210/+780	+405/-235	+105/-105	120	0	1310

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS L - Flaps 30

VREF30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1060	+30/-5	25	-40/+145	+15/-15	+25/-25	45	0	30
AUTOBRAKE MAX	1335	+25/-5	35	-55/+190	0/0	+35/-35	65	0	0
AUTOBRAKE 2	2360	+55/-10	70	-115/+395	0/0	+70/-70	140	0	0

Good Reported Braking Action

MAX MANUAL	1595	+30/-10	45	-75/+265	+50/-45	+40/-40	70	0	145
AUTOBRAKE MAX	1620	+35/-10	45	-75/+265	+45/-40	+45/-45	75	0	145
AUTOBRAKE 2	2360	+55/-10	70	-115/+395	0/0	+70/-70	140	0	0

Medium Reported Braking Action

MAX MANUAL	2305	+50/-20	75	-125/+455	+145/-110	+65/-65	90	0	460
AUTOBRAKE MAX	2305	+50/-20	75	-125/+455	+145/-110	+65/-65	95	0	460
AUTOBRAKE 3	2345	+55/-15	75	-130/+455	+135/-75	+70/-70	110	0	465

Poor Reported Braking Action

MAX MANUAL	3185	+70/-35	115	-200/+760	+385/-230	+95/-95	110	0	1190
AUTOBRAKE MAX	3195	+70/-35	115	-200/+760	+390/-235	+95/-95	110	0	1195
AUTOBRAKE 3	3195	+70/-35	115	-200/+760	+390/-230	+95/-95	110	0	1195

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS L+C - Flaps 20****VREF30+20**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1420	+40/-5	35	-50/+175	+25/-20	+35/-35	65	0	55
AUTOBRAKE MAX	1605	+30/-5	40	-65/+210	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2930	+60/-10	85	-130/+440	0/0	+90/-90	155	0	0

Good Reported Braking Action

MAX MANUAL	2125	+40/-10	60	-90/+310	+75/-65	+60/-60	90	0	255
AUTOBRAKE MAX	2125	+40/-10	60	-90/+305	+80/-60	+60/-60	95	0	245
AUTOBRAKE 2	2930	+60/-10	85	-130/+440	0/0	+90/-90	155	0	0

Medium Reported Braking Action

MAX MANUAL	3040	+65/-25	100	-150/+525	+195/-150	+90/-90	120	0	770
AUTOBRAKE MAX	3040	+65/-25	100	-150/+520	+205/-155	+90/-90	120	0	760
AUTOBRAKE 3	3040	+65/-20	100	-150/+520	+205/-140	+90/-90	125	0	765

Poor Reported Braking Action

MAX MANUAL	4140	+90/-45	155	-235/+860	+500/-305	+125/-125	140	0	1920
AUTOBRAKE MAX	4140	+90/-45	155	-235/+860	+515/-315	+130/-130	140	0	1915
AUTOBRAKE 3	4140	+90/-45	155	-235/+860	+515/-315	+130/-130	140	0	1915

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS L+R - Flaps 20****VREF30+20**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1530	+40/-5	40	-60/+205	+35/-30	+40/-40	70	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	2545	+50/-10	75	-120/+400	+135/-110	+75/-75	115	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	4095	+75/-20	125	-215/+745	+470/-305	+130/-130	160	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	6545	+110/-35	210	-400/+1475	+2250/-810	+210/-210	200	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS R - Flaps 25****VREF25**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1245	+20/-10	30	-50/+170	+25/-20	+30/-30	50	0	50
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	1870	+30/-20	55	-90/+310	+70/-60	+50/-50	75	0	220
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	2660	+45/-30	90	-145/+525	+185/-135	+80/-80	95	0	640
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	3595	+65/-50	130	-230/+875	+515/-280	+110/-110	110	0	1565
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS R - Flaps 30****VREF30**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1165	+20/-5	30	-50/+165	+20/-20	+30/-30	50	0	45
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	1730	+35/-10	50	-85/+300	+65/-55	+45/-45	75	0	190
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	2440	+55/-20	80	-140/+505	+170/-125	+70/-70	90	0	545
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	3295	+70/-35	120	-220/+845	+480/-260	+100/-100	105	0	1330
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****HYD PRESS SYS R+C - Flaps 20****VREF30+20**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1755	+30/-5	50	-70/+235	+45/-40	+45/-45	80	0	130
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Good Reported Braking Action

MAX MANUAL	2605	+55/-15	80	-120/+410	+130/-105	+75/-75	110	0	480
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								

Medium Reported Braking Action

MAX MANUAL	3625	+80/-35	130	-190/+680	+325/-225	+110/-110	135	0	1295
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Poor Reported Braking Action

MAX MANUAL	4795	+105/-55	185	-295/+1110	+915/-430	+150/-150	150	0	3035
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****PITCH UP AUTHORITY - (Flaps ≤ 15)****VREF30+40**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1290	+50/-5	35	-45/+175	+15/-15	+30/-30	40	40	85
AUTOBRAKE MAX	1910	+35/-5	50	-70/+230	0/0	+50/-50	80	0	0
AUTOBRAKE 2	3265	+65/-40	110	-140/+460	+70/-85	+95/-95	100	280	290

Good Reported Braking Action

MAX MANUAL	1880	+35/-15	55	-80/+265	+45/-40	+50/-50	60	150	365
AUTOBRAKE MAX	2010	+35/-10	55	-80/+280	+25/-20	+55/-55	80	110	335
AUTOBRAKE 2	3265	+65/-40	110	-140/+460	+70/-85	+95/-95	100	280	290

Medium Reported Braking Action

MAX MANUAL	2570	+50/-25	85	-120/+430	+110/-90	+75/-75	75	385	1050
AUTOBRAKE MAX	2580	+50/-25	90	-120/+430	+105/-85	+75/-75	80	385	1050
AUTOBRAKE 3	3135	+60/-30	100	-140/+485	+75/-75	+95/-95	105	185	640

Poor Reported Braking Action

MAX MANUAL	3285	+70/-40	125	-175/+650	+240/-165	+100/-100	85	775	2450
AUTOBRAKE MAX	3290	+70/-40	125	-175/+650	+240/-170	+100/-100	85	775	2450
AUTOBRAKE 3	3505	+75/-40	125	-180/+670	+210/-155	+105/-105	105	620	2295

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****PITCH UP AUTHORITY - (Flaps ≥ 20)****VREF30+20**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1145	+40/-5	25	-45/+145	+15/-15	+25/-25	40	30	65
AUTOBRAKE MAX	1605	+30/-5	40	-65/+210	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2805	+60/-30	90	-130/+430	+40/-65	+80/-80	95	120	120

Good Reported Braking Action

MAX MANUAL	1660	+30/-10	45	-75/+250	+45/-35	+45/-45	55	115	280
AUTOBRAKE MAX	1725	+35/-5	50	-75/+260	+40/-25	+45/-45	75	120	295
AUTOBRAKE 2	2805	+60/-30	90	-130/+430	+40/-65	+80/-80	95	120	120

Medium Reported Braking Action

MAX MANUAL	2265	+45/-20	75	-115/+405	+100/-80	+65/-65	75	310	815
AUTOBRAKE MAX	2265	+50/-20	75	-115/+405	+105/-75	+65/-65	80	305	815
AUTOBRAKE 3	2660	+55/-25	80	-130/+450	+55/-55	+80/-80	115	120	520

Poor Reported Braking Action

MAX MANUAL	2905	+65/-35	105	-165/+620	+225/-155	+85/-85	85	630	1925
AUTOBRAKE MAX	2910	+65/-35	105	-165/+625	+230/-155	+85/-85	85	630	1930
AUTOBRAKE 3	3035	+65/-35	105	-170/+635	+190/-130	+90/-90	110	540	1845

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****PRIMARY FLIGHT COMPUTERS - Flaps 20****VREF20**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1295	+30/-15	30	-50/+160	+20/-15	+30/-30	50	35	85
AUTOBRAKE MAX	1570	+20/-20	40	-60/+205	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2845	+45/-45	85	-130/+435	+5/-30	+85/-85	135	10	10

Good Reported Braking Action

MAX MANUAL	1850	+30/-25	55	-80/+275	+50/-45	+50/-50	75	150	365
AUTOBRAKE MAX	1850	+30/-25	55	-80/+270	+50/-45	+50/-50	75	145	355
AUTOBRAKE 2	2845	+45/-45	85	-130/+435	+5/-30	+85/-85	135	10	10

Medium Reported Braking Action

MAX MANUAL	2495	+45/-35	85	-125/+435	+120/-95	+70/-70	90	385	1060
AUTOBRAKE MAX	2495	+45/-35	85	-120/+435	+125/-100	+70/-70	90	380	1050
AUTOBRAKE 3	2650	+40/-35	80	-130/+450	+80/-45	+80/-80	130	225	895

Poor Reported Braking Action

MAX MANUAL	3180	+60/-50	120	-180/+655	+260/-175	+95/-95	105	775	2515
AUTOBRAKE MAX	3180	+60/-50	120	-180/+655	+265/-185	+95/-95	105	775	2515
AUTOBRAKE 3	3195	+60/-50	120	-180/+660	+260/-160	+95/-95	115	760	2500

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****SLATS DRIVE - Flaps 20****VREF30+30**

	LANDING DISTANCES AND ADJUSTMENTS (M)							
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV NO REV

Dry Runway

MAX MANUAL	1230	+45/-5	30	-45/+150	+15/-15	+30/-30	40	35	75
AUTOBRAKE MAX	1750	+30/-5	45	-65/+220	0/0	+45/-45	80	0	0
AUTOBRAKE 2	3030	+60/-35	100	-135/+445	+60/-75	+90/-90	95	190	190

Good Reported Braking Action

MAX MANUAL	1785	+30/-15	50	-75/+260	+45/-40	+50/-50	60	135	320
AUTOBRAKE MAX	1875	+35/-5	55	-80/+270	+35/-20	+50/-50	80	130	325
AUTOBRAKE 2	3030	+60/-35	100	-135/+445	+60/-75	+90/-90	95	190	190

Medium Reported Braking Action

MAX MANUAL	2430	+50/-25	80	-120/+420	+110/-85	+70/-70	75	340	905
AUTOBRAKE MAX	2440	+50/-25	80	-120/+420	+110/-80	+70/-70	80	340	905
AUTOBRAKE 3	2905	+55/-30	90	-135/+470	+65/-70	+85/-85	105	150	565

Poor Reported Braking Action

MAX MANUAL	3110	+65/-40	115	-170/+640	+235/-160	+90/-90	85	685	2100
AUTOBRAKE MAX	3115	+65/-40	115	-170/+640	+240/-165	+95/-95	85	690	2100
AUTOBRAKE 3	3280	+70/-40	115	-175/+655	+200/-150	+100/-100	105	565	1990

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****STABILIZER - Flaps 20****VREF30+20**

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	260000 KG LDG WT	PER 5000 KG ABV/BLW 260000 KG	PER 1000 FT ABOVE SEA LEVEL	HEAD/ TAIL WIND	DOWN/ UP HILL	ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV

Dry Runway

MAX MANUAL	1145	+40/-5	25	-45/+145	+15/-15	+25/-25	40	30	65
AUTOBRAKE MAX	1605	+30/-5	40	-65/+210	0/0	+40/-40	75	0	0
AUTOBRAKE 2	2805	+60/-30	90	-130/+430	+40/-65	+80/-80	95	120	120

Good Reported Braking Action

MAX MANUAL	1660	+30/-10	45	-75/+250	+45/-35	+45/-45	55	115	280
AUTOBRAKE MAX	1725	+35/-5	50	-75/+260	+40/-25	+45/-45	75	120	295
AUTOBRAKE 2	2805	+60/-30	90	-130/+430	+40/-65	+80/-80	95	120	120

Medium Reported Braking Action

MAX MANUAL	2265	+45/-20	75	-115/+405	+100/-80	+65/-65	75	310	815
AUTOBRAKE MAX	2265	+50/-20	75	-115/+405	+105/-75	+65/-65	80	305	815
AUTOBRAKE 3	2660	+55/-25	80	-130/+450	+55/-55	+80/-80	115	120	520

Poor Reported Braking Action

MAX MANUAL	2905	+65/-35	105	-165/+620	+225/-155	+85/-85	85	630	1925
AUTOBRAKE MAX	2910	+65/-35	105	-165/+625	+230/-155	+85/-85	85	630	1930
AUTOBRAKE 3	3035	+65/-35	105	-170/+635	+190/-130	+90/-90	110	540	1845

Reference distance is for sea level, standard day, no wind or slope, and maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (305 meters of air distance).

ADVISORY INFORMATION**Landing Climb Limit Weight****Valid for approach with flaps 20 and landing with flaps 30**

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
54	129	297.3	279.1				
52	126	306.3	287.0				
50	122	315.2	294.5	269.7			
48	118	323.5	303.4	276.9			
46	115	331.8	312.4	284.1	259.6		
44	111	340.4	321.1	291.5	267.7		
42	108	349.8	329.0	299.1	275.0	251.6	
40	104	356.7	337.3	307.2	281.4	257.0	
38	100	363.8	347.0	316.0	287.8	262.8	233.8
36	97	366.6	354.0	323.2	293.4	269.2	238.4
34	93	366.8	360.8	330.4	299.7	274.4	243.0
32	90	367.1	363.3	337.6	306.4	278.7	247.1
30	86	367.3	363.4	344.5	312.9	282.9	250.9
28	82	367.6	363.6	350.2	318.7	287.3	254.6
26	79	367.9	363.7	350.4	322.6	292.2	258.2
24	75	368.1	363.9	350.5	326.0	297.0	263.1
22	72	368.4	364.0	350.5	327.4	300.3	268.1
20	68	368.6	364.1	350.6	327.5	302.5	272.4
18	64	368.9	364.3	350.7	327.6	304.7	275.2
16	61	369.2	364.4	350.8	327.6	304.7	276.9
14	57	369.4	364.5	350.8	327.7	304.8	278.5
12	54	369.6	364.6	350.9	327.8	304.9	278.6
10	50	369.8	364.7	351.0	327.9	304.9	278.7
8	46	369.9	364.8	351.1	327.9	304.9	278.7
6	43	370.0	364.9	349.7	328.0	304.9	272.8
4	40	370.1	365.0	341.5	313.7	286.7	254.9
2	36	370.2	365.1	341.5	313.8	286.8	254.9
0	32	370.3	365.1	341.5	313.8	286.8	255.0
-40	-40	371.0	365.4	341.6	313.8	286.8	255.0

Based on engine bleed for packs on, engine anti-ice off, and wing anti-ice off.

With engine bleed for packs off, increase weight by 1250 kg.

With engine anti-ice on, decrease weight by 150 kg.

With engine and wing anti-ice on, decrease weight by 2350 kg.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 24600 kg.

ADVISORY INFORMATION

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 25

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
54	129	302.7	284.5				
52	126	310.0	292.5				
50	122	317.6	300.2	275.6			
48	118	325.1	307.8	282.4			
46	115	332.9	315.3	289.8	267.1		
44	111	340.7	322.9	297.4	273.6		
42	108	348.8	330.3	304.4	280.1	258.9	
40	104	355.6	337.9	311.1	286.7	264.5	
38	100	362.7	345.9	318.5	293.4	269.9	241.1
36	97	365.5	352.9	325.0	299.2	275.1	245.9
34	93	365.7	359.6	331.6	305.0	279.9	250.6
32	90	366.0	362.1	338.2	310.6	284.3	254.9
30	86	366.3	362.2	344.3	315.9	288.7	259.0
28	82	366.5	362.4	349.1	320.8	293.2	262.9
26	79	366.8	362.5	349.3	324.4	298.1	266.5
24	75	367.0	362.7	349.4	327.7	302.6	270.7
22	72	367.3	362.8	349.4	329.0	305.5	274.7
20	68	367.5	362.9	349.5	329.1	307.3	278.2
18	64	367.8	363.0	349.6	329.1	309.0	281.0
16	61	368.1	363.2	349.7	329.2	309.1	282.8
14	57	368.3	363.3	349.7	329.3	309.1	284.4
12	54	368.5	363.4	349.8	329.3	309.2	284.5
10	50	368.6	363.5	349.9	329.4	309.2	284.5
8	46	368.8	363.6	350.0	329.5	309.3	284.6
6	43	368.9	363.7	350.0	329.5	309.3	284.5
4	40	369.0	363.8	350.1	329.6	309.3	278.4
2	36	369.1	363.8	350.1	329.6	309.4	278.4
0	32	369.2	363.9	350.1	329.7	309.4	278.4
-40	-40	369.8	364.1	350.3	329.8	309.6	278.5

Based on engine bleed for packs on, engine anti-ice off, and wing anti-ice off.

With engine bleed for packs off, increase weight by 1400 kg.

With engine anti-ice on, decrease weight by 100 kg.

With engine and wing anti-ice on, decrease weight by 2300 kg.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 22400 kg.

ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Reference Brake Energy (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)																							
		80				100				120				140				160				180			
WEIGHT (1000 KG)	OAT (°C)	PRESSURE ALTITUDE (1000 FT)																							
		0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8			
360	0	23.3	25.7	28.3	33.8	37.7	41.9	46.1	51.6	57.8	59.8	67.3	75.6	74.5	84.0	94.5	89.8	101.1	113.6						
	10	23.9	26.4	29.2	34.8	38.8	43.2	47.5	53.2	59.6	61.7	69.4	78.0	76.9	86.6	97.4	92.6	104.1	116.9						
	15	24.4	26.9	29.7	35.5	39.5	44.0	48.4	54.2	60.7	62.8	70.6	79.4	78.3	88.1	99.1	94.2	105.9	118.8						
	20	24.8	27.4	30.2	36.1	40.2	44.8	49.2	55.2	61.8	63.9	71.9	80.8	79.6	89.6	100.8	95.8	107.6	120.6						
	30	25.5	28.1	31.0	37.1	41.3	46.1	50.6	56.7	63.6	65.8	74.0	83.1	81.9	92.2	103.6	98.5	110.6	123.9						
340	0	22.2	24.4	27.0	32.3	35.9	39.9	43.9	49.1	55.0	56.9	64.0	71.9	71.0	79.9	90.0	85.6	96.4	108.4						
	10	22.9	25.2	27.8	33.2	37.0	41.1	45.2	50.6	56.7	58.7	66.0	74.2	73.2	82.4	92.8	88.3	99.3	111.6						
	15	23.3	25.7	28.3	33.9	37.7	41.9	46.1	51.6	57.7	59.8	67.2	75.5	74.5	83.9	94.4	89.8	101.0	113.4						
	20	23.7	26.2	28.8	34.5	38.4	42.7	46.9	52.5	58.8	60.8	68.4	76.8	75.8	85.4	96.0	91.3	102.7	115.3						
	30	24.3	26.8	29.6	35.4	39.4	43.9	48.2	54.0	60.5	62.6	70.3	79.0	78.0	87.8	98.7	94.0	105.8	118.4						
320	0	21.2	23.4	25.7	30.7	34.2	37.9	41.7	46.6	52.2	54.0	60.7	68.1	67.3	75.8	85.3	81.3	91.5	103.0						
	10	21.8	24.0	26.5	31.6	35.2	39.1	43.0	48.1	53.8	55.7	62.6	70.3	69.5	78.2	88.0	83.8	94.4	106.1						
	15	22.2	24.5	27.0	32.2	35.8	39.8	43.8	49.0	54.8	56.7	63.7	71.5	70.7	79.6	89.5	85.3	96.0	107.9						
	20	22.6	24.9	27.5	32.8	36.5	40.5	44.6	49.8	55.7	57.7	64.8	72.8	72.0	81.0	91.1	86.8	97.6	109.7						
	30	23.2	25.6	28.2	33.7	37.5	41.6	45.8	51.2	57.3	59.4	66.7	74.9	74.0	83.3	93.7	89.3	100.4	112.7						
300	0	20.2	22.5	24.8	29.2	32.4	36.0	39.5	44.1	49.3	51.1	57.3	64.3	63.7	71.6	80.6	76.8	86.6	97.5						
	10	20.8	22.9	25.1	30.0	33.4	37.0	40.7	45.5	50.8	52.7	59.1	66.4	65.7	73.9	83.1	79.3	89.3	100.4						
	15	21.2	23.3	25.6	30.6	34.0	37.7	41.5	46.3	51.8	53.6	60.2	67.6	66.8	75.2	84.6	80.7	90.8	102.1						
	20	21.6	23.7	26.1	31.2	34.6	38.4	42.2	47.2	52.7	54.6	61.3	68.8	68.0	76.5	86.1	82.1	92.4	103.8						
	30	22.1	24.3	26.8	32.0	35.5	39.4	43.4	48.5	54.2	56.1	63.0	70.7	70.0	78.8	88.5	84.4	95.0	106.7						
260	0	18.2	20.6	22.1	26.1	28.9	32.0	35.1	39.1	43.6	45.2	50.6	56.6	56.1	63.1	70.9	67.7	76.2	85.8						
	10	18.7	20.6	22.5	26.9	29.7	32.9	36.2	40.3	44.9	46.5	52.1	58.4	57.9	65.1	73.1	69.8	78.6	88.5						
	15	19.1	20.9	23.0	27.4	30.3	33.6	36.8	41.1	45.8	47.4	53.1	59.5	58.9	66.2	74.4	71.1	80.0	90.0						
	20	19.4	21.3	23.4	27.9	30.9	34.2	37.5	41.8	46.6	48.3	54.1	60.6	60.0	67.4	75.7	72.4	81.4	91.6						
	30	19.9	21.9	24.0	28.6	31.7	35.1	38.5	43.0	47.9	49.6	55.6	62.3	61.7	69.4	77.9	74.4	83.8	94.2						
220	0	16.3	17.8	19.5	23.1	25.4	28.1	30.7	34.1	37.9	39.2	43.7	48.9	48.4	54.2	60.8	58.2	65.4	73.5						
	10	16.7	18.3	20.0	23.7	26.2	28.9	31.6	35.1	39.0	40.3	45.1	50.4	49.9	55.9	62.7	60.0	67.4	75.8						
	15	17.1	18.7	20.4	24.2	26.7	29.4	32.2	35.8	39.8	41.1	45.9	51.3	50.8	57.0	63.9	61.1	68.7	77.2						
	20	17.4	19.0	20.8	24.6	27.1	30.0	32.8	36.4	40.5	41.8	46.7	52.2	51.7	58.0	65.0	62.2	69.9	78.5						
	30	17.8	19.5	21.3	25.2	27.8	30.7	33.7	37.4	41.6	43.0	48.1	53.7	53.2	59.6	66.9	63.9	71.9	80.8						
180	0	14.4	15.7	17.1	20.0	22.0	24.2	26.3	29.1	32.2	33.1	36.8	41.0	40.4	45.2	50.5	48.2	54.0	60.6						
	10	14.8	16.1	17.6	20.6	22.6	24.9	27.0	29.9	33.1	34.1	37.9	42.2	41.6	46.5	52.0	49.7	55.7	62.5						
	15	15.1	16.4	17.9	21.0	23.0	25.3	27.5	30.5	33.7	34.7	38.6	43.0	42.4	47.4	53.0	50.6	56.7	63.6						
	20	15.4	16.7	18.2	21.3	23.5	25.8	28.0	31.0	34.4	35.3	39.3	43.8	43.2	48.3	53.9	51.5	57.8	64.8						
	30	15.7	17.1	18.7	21.9	24.1	26.5	28.8	31.8	35.3	36.3	40.4	45.0	44.4	49.6	55.5	53.0	59.4	66.6						

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.

If ground speed is used for brakes on speed, ignore wind and enter table with sea level, 15°C.

ADVISORY INFORMATION**Recommended Brake Cooling Schedule****Event Adjusted Brake Energy (Millions of Foot Pounds)****No Reverse Thrust**

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)											
EVENT		10	20	30	40	50	60	70	80	90	100	110	120
LANDING	RTO MAX MAN	10	20	30	40	50	60	70	80	90	100	110	120
	MAX MAN	3.6	13.6	23.5	33.2	42.8	52.3	61.8	71.4	81.0	90.6	100.5	110.4
	MAX AUTO	3.5	12.5	21.4	30.2	39.0	47.8	56.8	66.0	75.5	85.5	95.9	106.8
	AUTOBRAKE 4	3.2	11.7	20.0	28.0	36.0	44.0	52.2	60.6	69.4	78.7	88.6	99.2
	AUTOBRAKE 3	2.7	11.0	18.8	26.3	33.7	41.0	48.4	56.1	64.2	72.8	82.0	92.2
	AUTOBRAKE 2	2.3	10.2	17.5	24.5	31.2	37.9	44.6	51.5	58.9	66.7	75.2	84.6
	AUTOBRAKE 1	1.9	9.0	15.6	21.8	27.8	33.8	39.8	45.9	52.4	59.4	66.9	75.1

2 Engine Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)											
EVENT		10	20	30	40	50	60	70	80	90	100	110	120
LANDING	RTO MAX MAN	10	20	30	40	50	60	70	80	90	100	110	120
	MAX MAN	3.4	12.0	21.2	30.6	39.7	48.6	57.4	65.9	74.4	82.8	91.3	99.7
	MAX AUTO	2.0	8.8	15.9	23.2	30.5	38.0	45.7	53.7	62.1	71.0	80.6	90.9
	AUTOBRAKE 4	1.3	5.6	10.9	16.6	22.5	28.3	34.3	40.7	47.5	54.9	63.0	72.0
	AUTOBRAKE 3	0.8	3.1	7.0	11.6	16.2	20.9	25.8	30.9	36.6	42.7	49.6	57.3
	AUTOBRAKE 2	0.0	2.3	5.0	7.8	10.8	14.0	17.4	21.2	25.6	30.4	36.0	42.4
	AUTOBRAKE 1	0.0	1.6	3.3	5.2	7.2	9.4	11.8	14.4	17.4	20.8	24.7	29.2

Cooling Time (Minutes)

		EVENT ADJUSTED BRAKE ENERGY (MILLIONS OF FOOT POUNDS)									
		16 & BELOW	17	18	20	24	28	32	35	36 TO 44	45 & ABOVE
GEAR DOWN	NO SPECIAL	PROCEDURE REQUIRED	1	2	3	4	6	7	7	CAUTION	FUSE PLUG MELT ZONE
INFLIGHT											
GROUND			11	18	26	42	55	66	73		
BTMS	UP TO 2.4	2.4	2.6	2.9	3.4	4.0	4.5	4.9	5.0 TO 6.3	6.3 & ABOVE	

Observe maximum quick turnaround limit.

Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.

Add 1.0 million foot pounds for each taxi mile.

For one brake deactivated, increase brake energy by 10 percent.

For two brakes deactivated, increase brake energy by 20 percent.

When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after one hour. If overheat occurs after takeoff, extend gear soon for at least 8 minutes.

When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not attempt to taxi for one hour. Tire, wheel and brake replacement may be required. If overheat occurs after takeoff, extend gear soon for at least 12 minutes.

Brake temperature monitor system (BTMS) indication on EICAS may be used 10 to 15 minutes after airplane has come to a complete stop, or inflight with gear retracted, to determine recommended cooling schedule. (When inflight with gear extended, the BTMS indications may vary between individual brakes, due to air-stream effects.)

Performance Inflight
Engine Inoperative

Chapter PI
Section 43

ENGINE INOP

Initial Max Continuous %N1
Based on .84M, engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	97.4	97.0	96.7	96.3	95.9	95.9	95.6	95.3	95.0
15	98.2	97.8	97.3	97.0	96.6	96.3	96.0	95.7	95.4
10	99.2	98.9	98.3	97.7	97.2	97.0	96.6	96.3	96.0
5	100.2	100.1	99.7	98.8	98.1	97.8	97.4	97.1	96.8
0	99.3	100.9	101.0	99.9	99.3	98.8	98.3	97.9	97.6
-5	98.4	99.9	101.2	101.3	100.5	100.2	99.7	99.3	98.8
-10	97.4	99.0	100.3	101.6	101.3	101.3	100.7	100.3	100.0
-15	96.5	98.1	99.3	100.6	101.0	102.0	101.1	100.8	100.5
-20	95.6	97.1	98.3	99.6	100.1	101.0	100.1	99.8	99.5
-25	94.6	96.1	97.4	98.6	99.1	100.0	99.1	98.8	98.5
-30	93.7	95.2	96.4	97.6	98.1	99.0	98.1	97.8	97.5
-35	92.7	94.2	95.4	96.6	97.0	97.9	97.1	96.8	96.5
-40	91.7	93.2	94.4	95.6	96.0	96.9	96.1	95.8	95.5

ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
37000 FT to 27000 FT Pressure Altitudes

37000 FT PRESS ALT												TAT (°C)	
CIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
280	0.86	94.3	95.4	96.4	97.4	98.4	99.5	100.5	101.4	101.2	100.2	98.9	97.7
240	0.74	96.1	97.2	98.3	99.3	100.4	101.4	102.1	101.9	100.9	99.5	98.1	97.1
200	0.63	95.7	96.7	97.8	98.8	99.9	100.8	101.4	100.9	100.0	98.5	97.0	96.3
35000 FT PRESS ALT												TAT (°C)	
CIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
280	0.82	94.6	95.6	96.6	97.7	98.7	99.7	100.7	101.7	101.4	100.4	99.2	98.1
240	0.71	95.1	96.2	97.2	98.3	99.3	100.3	101.3	101.8	100.9	99.8	98.3	97.2
200	0.60	94.8	95.8	96.9	97.9	98.9	99.9	100.9	101.0	100.2	98.8	97.1	96.1
33000 FT PRESS ALT												TAT (°C)	
CIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
320	0.89	91.4	92.4	93.4	94.4	95.4	96.4	97.4	98.3	99.3	100.2	99.8	98.8
280	0.79	95.0	96.0	97.1	98.1	99.2	100.2	101.2	102.2	102.4	101.0	100.0	98.7
240	0.68	95.6	96.7	97.8	98.8	99.8	100.9	101.9	102.4	101.8	100.2	98.9	97.5
200	0.58	95.9	97.0	98.0	99.1	100.1	101.1	101.6	101.6	101.0	99.3	97.9	96.4
31000 FT PRESS ALT												TAT (°C)	
CIAS	M	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10
320	0.85	92.7	93.8	94.8	95.7	96.7	97.7	98.7	99.6	100.5	100.8	99.7	98.4
280	0.76	96.3	97.4	98.4	99.5	100.5	101.5	102.5	103.5	102.0	100.6	99.1	98.0
240	0.66	97.4	98.4	99.5	100.5	101.5	102.6	103.3	103.0	101.0	99.5	98.1	96.9
200	0.55	97.6	98.7	99.7	100.8	101.8	102.6	102.8	102.0	100.7	98.7	97.2	96.1
29000 FT PRESS ALT												TAT (°C)	
CIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
320	0.82	93.8	94.8	95.8	96.8	97.8	98.7	99.7	100.6	101.6	100.1	98.9	97.8
280	0.73	96.6	97.6	98.6	99.6	100.6	101.6	102.6	102.5	101.0	99.5	98.1	97.1
240	0.63	98.1	99.2	100.2	101.3	102.3	103.3	103.1	101.6	99.8	98.4	97.1	96.0
200	0.53	98.6	99.7	100.7	101.7	102.7	103.2	102.7	101.2	99.4	97.7	96.3	96.2
27000 FT PRESS ALT												TAT (°C)	
CIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
360	0.88	90.2	91.2	92.1	93.0	94.0	94.9	95.8	96.7	97.6	98.5	99.2	98.1
320	0.79	93.4	94.4	95.3	96.3	97.3	98.2	99.2	100.1	101.1	100.6	99.2	98.1
280	0.70	95.4	96.4	97.4	98.4	99.4	100.4	101.3	102.3	101.3	99.7	98.2	97.1
240	0.60	97.2	98.2	99.2	100.3	101.3	102.3	103.0	102.0	99.9	98.5	97.2	96.2
200	0.51	98.4	99.4	100.4	101.5	102.5	103.2	102.7	101.8	99.9	98.1	96.5	95.6

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	37	35	33	31	29	27
ENGINE A/I ON	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
WING A/I ON - PACKS ON	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3
WING A/I ON - PACKS OFF	-0.6	-0.5	-0.5	-0.5	-0.5	-0.4

ENGINE INOP**Max Continuous %N1****Based on engine bleed for packs on or off and anti-ice off****25000 FT to 18000 FT Pressure Altitudes**

25000 FT PRESS ALT			TAT (°C)										
KLAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
360	0.85	91.2	92.2	93.1	94.1	95.0	95.9	96.8	97.7	98.6	99.5	98.9	98.1
320	0.76	93.9	94.8	95.8	96.8	97.7	98.7	99.6	100.5	101.1	99.6	98.5	97.6
280	0.67	95.5	96.5	97.5	98.5	99.4	100.4	101.3	101.5	100.4	98.8	97.5	96.7
240	0.58	97.4	98.5	99.5	100.5	101.5	102.4	102.3	100.9	99.3	97.8	96.7	95.9
200	0.49	99.3	100.3	101.4	102.4	103.4	103.1	102.0	100.6	98.5	97.1	96.1	95.9
24000 FT PRESS ALT			TAT (°C)										
KLAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
360	0.83	91.3	92.3	93.2	94.2	95.1	96.0	96.9	97.8	98.7	99.6	99.4	98.4
320	0.75	93.6	94.6	95.6	96.5	97.5	98.4	99.4	100.3	101.2	100.0	98.8	97.8
280	0.66	95.4	96.4	97.4	98.3	99.3	100.3	101.2	101.8	100.7	99.1	97.8	96.9
240	0.57	97.3	98.3	99.3	100.3	101.3	102.2	102.6	101.4	99.8	98.3	97.1	96.2
200	0.48	98.8	99.9	100.9	101.9	102.9	103.4	102.3	101.0	98.9	97.4	96.3	95.6
22000 FT PRESS ALT			TAT (°C)										
KLAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
360	0.80	92.1	93.0	94.0	94.9	95.8	96.7	97.6	98.5	99.4	100.0	99.0	98.3
320	0.72	94.3	95.3	96.3	97.2	98.1	99.1	100.0	100.9	100.7	99.3	98.2	97.5
280	0.63	96.1	97.1	98.1	99.0	100.0	100.9	101.9	101.3	99.8	98.4	97.3	96.6
240	0.55	97.7	98.7	99.7	100.7	101.7	102.7	102.3	100.9	99.3	97.7	96.8	96.1
200	0.46	99.5	100.5	101.5	102.5	103.5	103.0	101.5	99.9	97.9	96.8	95.9	95.8
20000 FT PRESS ALT			TAT (°C)										
KLAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
360	0.77	93.7	94.6	95.6	96.5	97.4	98.4	99.3	100.2	101.1	102.0	101.3	100.1
320	0.69	95.9	96.9	97.8	98.8	99.7	100.7	101.6	102.6	103.5	101.8	100.4	99.1
280	0.61	97.7	98.7	99.6	100.6	101.6	102.6	103.5	104.3	102.8	100.9	99.4	98.3
240	0.53	98.5	99.5	100.5	101.5	102.4	103.4	104.3	104.1	102.4	100.7	98.7	97.2
200	0.44	98.0	99.0	99.9	100.9	101.9	102.9	103.8	102.6	100.5	98.0	96.2	95.3
18000 FT PRESS ALT			TAT (°C)										
KLAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
360	0.75	94.4	95.4	96.3	97.2	98.2	99.1	100	100.9	101.8	102.0	100.6	99.4
320	0.67	96.7	97.7	98.6	99.6	100.5	101.4	102.4	103.3	102.9	101.2	99.7	98.6
280	0.59	98.5	99.5	100.5	101.5	102.4	103.4	104.3	104.0	102.3	100.4	98.9	97.8
240	0.51	99.6	100.6	101.6	102.6	103.6	104.5	104.9	103.9	101.9	100.0	98.4	97.2
200	0.42	97.2	98.2	99.2	100.1	101.1	101.9	102.0	100.8	98.8	97.3	95.8	94.4

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	25	24	22	20	18
ENGINE A/I ON	-0.2	-0.2	-0.2	-0.2	-0.2
WING A/I ON - PACKS ON	-0.3	-0.3	-0.3	-0.2	-0.3
WING A/I ON - PACKS OFF	-0.4	-0.4	-0.4	-0.3	-0.5

ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
16000 FT to 5000 FT Pressure Altitudes

16000 FT PRESS ALT			TAT (°C)										
CIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
360	0.72	94.8	95.8	96.7	97.6	98.6	99.5	100.4	101.3	102.2	103.1	101.7	100.2
320	0.64	96.9	97.9	98.8	99.8	100.7	101.7	102.6	103.5	104.4	102.7	100.9	99.4
280	0.57	98.7	99.7	100.7	101.6	102.6	103.5	104.5	105.4	104.1	102.2	100.3	98.8
240	0.49	99.1	100.1	101.1	102.0	103.0	104.0	104.9	104.5	103.0	100.9	99.2	97.9
200	0.41	96.2	97.2	98.1	99.1	100.0	100.9	101.5	101.3	99.8	98.3	97.0	95.4
14000 FT PRESS ALT			TAT (°C)										
CIAS	M	-20	-15	-10	-5	0	5	10	15	20	25	30	35
360	0.69	94.9	95.9	96.8	97.7	98.6	99.5	100.4	101.3	102.2	102.2	100.8	99.5
320	0.62	97.1	98.1	99.0	99.9	100.9	101.8	102.7	103.6	103.4	101.5	100.0	98.9
280	0.54	99.2	100.1	101.1	102.1	103.0	103.9	104.9	104.9	103.0	101.0	99.5	98.4
240	0.47	97.3	98.2	99.2	100.1	101.0	102.0	102.7	102.5	100.6	99.0	97.8	96.7
200	0.39	96.1	97.0	98.0	98.9	99.8	100.7	101.4	100.7	99.0	97.6	96.5	95.6
12000 FT PRESS ALT			TAT (°C)										
CIAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40
360	0.67	95.4	96.3	97.2	98.1	99.0	99.9	100.8	101.6	102.5	101.3	100.0	99.0
320	0.60	97.3	98.2	99.2	100.1	101.0	101.9	102.8	103.7	102.3	100.6	99.4	98.4
280	0.52	99.7	100.6	101.6	102.5	103.5	104.4	105.3	104.0	102.0	100.2	99.1	98.1
240	0.45	96.5	97.4	98.3	99.3	100.2	101.1	101.4	100.6	99.2	98.0	96.9	96.0
200	0.38	96.7	97.7	98.6	99.5	100.4	101.2	101.3	100.2	98.7	97.4	96.4	95.8
10000 FT PRESS ALT			TAT (°C)										
CIAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40
360	0.65	94.2	95.2	96.1	96.9	97.8	98.7	99.6	100.4	101.3	101.5	100.2	99.1
320	0.58	96.1	97.1	98.0	98.9	99.8	100.7	101.6	102.4	102.6	101.0	99.7	98.6
280	0.51	98.5	99.4	100.4	101.3	102.2	103.1	104.0	104.6	102.3	100.5	99.4	98.4
240	0.43	95.6	96.6	97.5	98.4	99.3	100.2	101.0	101.1	100.3	99.1	97.8	96.9
200	0.36	96.6	97.5	98.4	99.3	100.2	101.1	101.6	101.2	100.1	98.5	97.5	96.6
5000 FT PRESS ALT			TAT (°C)										
CIAS	M	-10	-5	0	5	10	15	20	25	30	35	40	45
360	0.59	92.6	93.5	94.3	95.2	96.0	96.9	97.7	98.5	99.4	100.2	99.3	98.5
320	0.53	94.0	94.9	95.8	96.7	97.5	98.4	99.2	100.1	100.9	100.1	99.1	98.2
280	0.46	95.0	95.9	96.8	97.6	98.5	99.4	100.2	101.1	100.9	99.8	98.8	97.8
240	0.40	95.7	96.6	97.5	98.4	99.3	100.2	101.0	101.6	100.5	99.4	98.3	97.4
200	0.33	97.0	97.9	98.8	99.7	100.6	101.5	102.4	101.7	100.3	99.1	98.1	97.3

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	16	14	12	10	5
ENGINE A/I ON	-0.3	-0.2	-0.4	-0.5	-0.5
WING A/I ON - PACKS ON	-0.4	-0.5	-0.6	-0.7	-0.8
WING A/I ON - PACKS OFF	-0.6	-0.7	-0.8	-0.9	-1.1

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

Includes APU fuel burn

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
360	350	301	18000	16900	15700
340	331	293	19500	18400	17300
320	312	285	20900	20200	19100
300	291	276	22400	21500	20600
280	272	266	24200	23200	22000
260	252	257	26200	25300	24000
240	233	248	28500	27700	26300
220	214	238	30500	30000	28900
200	195	227	32300	32000	31300
180	175	215	34300	34100	33800
160	155	203	36500	36400	36200

ENGINE INOP

MAX CONTINUOUS THRUST

**Driftdown/LRC Cruise Range Capability
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
134	125	118	111	105	100	95	90	86	82	79
268	251	236	222	210	200	190	181	173	166	159
402	376	354	333	316	300	285	272	260	249	239
535	501	471	445	421	400	380	363	347	332	319
668	626	588	555	526	500	476	454	434	416	399
800	750	706	666	631	600	571	545	521	499	479
932	874	823	777	736	700	666	636	608	583	560
1064	998	940	888	841	800	762	727	696	667	640
1196	1122	1057	998	946	900	857	818	783	751	721
1327	1246	1173	1109	1051	1000	952	910	870	835	801
1459	1369	1290	1220	1156	1100	1048	1001	958	918	882
1590	1493	1407	1330	1262	1200	1143	1092	1045	1002	963
1722	1617	1524	1441	1367	1300	1239	1183	1133	1086	1043
1854	1741	1641	1552	1472	1400	1334	1275	1220	1170	1124
1986	1865	1758	1662	1577	1500	1430	1366	1307	1254	1205
2118	1989	1875	1773	1682	1600	1525	1457	1395	1338	1285
2250	2113	1992	1884	1787	1700	1620	1548	1482	1421	1365
2383	2238	2109	1995	1892	1800	1716	1639	1569	1505	1446

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG)											TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 KG)											
	160	180	200	220	240	260	280	300	320	340	360	
100	1.0	1.1	1.2	1.4	1.4	1.6	1.7	1.7	1.8	1.9	2.0	0:15
200	2.3	2.5	2.8	3.0	3.2	3.4	3.6	3.8	4.1	4.3	4.5	0:31
300	3.6	3.9	4.4	4.8	5.1	5.4	5.8	6.1	6.5	6.9	7.2	0:46
400	4.9	5.4	6.0	6.6	7.0	7.5	7.9	8.4	8.9	9.5	10.0	1:01
500	6.2	6.8	7.5	8.2	8.8	9.4	10.0	10.6	11.2	11.9	12.6	1:16
600	7.4	8.1	9.0	9.8	10.6	11.3	12.0	12.7	13.4	14.3	15.2	1:30
700	8.6	9.4	10.4	11.4	12.3	13.1	13.9	14.8	15.6	16.6	17.7	1:45
800	9.7	10.7	11.9	13.0	14.0	14.9	15.9	16.8	17.8	19.0	20.2	1:59
900	10.9	12.0	13.3	14.5	15.6	16.8	17.8	18.9	20.0	21.3	22.7	2:14
1000	12.1	13.3	14.7	16.1	17.3	18.5	19.7	20.9	22.1	23.6	25.2	2:28
1100	13.2	14.6	16.1	17.6	19.0	20.3	21.6	22.9	24.3	25.9	27.6	2:43
1200	14.4	15.9	17.5	19.1	20.6	22.1	23.5	24.9	26.4	28.1	30.0	2:57
1300	15.5	17.2	18.9	20.6	22.3	23.8	25.4	26.9	28.5	30.4	32.4	3:11
1400	16.6	18.4	20.3	22.1	23.9	25.6	27.2	28.9	30.6	32.6	34.8	3:26
1500	17.7	19.6	21.7	23.6	25.5	27.3	29.1	30.9	32.7	34.8	37.2	3:40
1600	18.8	20.9	23.0	25.1	27.1	29.0	30.9	32.8	34.8	37.0	39.5	3:55
1700	19.9	22.1	24.4	26.6	28.7	30.7	32.8	34.8	36.8	39.2	41.9	4:10
1800	21.0	23.3	25.7	28.0	30.2	32.4	34.6	36.7	38.9	41.4	44.2	4:24

Includes APU fuel burn.
Driftdown at optimum driftdown speed and cruise at LRC speed.

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability

100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
360	15600	14200	12700
350	16000	14700	13200
340	16900	15200	13700
330	17800	16300	14600
320	18800	17300	15600
310	19800	18300	16600
300	20500	19300	17700
290	21100	20200	18700
280	21800	20800	19800
270	22700	21500	20600
260	23600	22300	21200
250	24600	23400	21900
240	25800	24600	23100
230	27100	25900	24300
220	28500	27300	25600
210	29900	28600	27100
200	30900	30000	28500
190	31900	31200	30100
180	32900	32500	31400
170	34000	33700	32800
160	35200	35100	34300

With engine anti-ice on, no altitude capability adjustment is required.

With engine and wing anti-ice on, decrease altitude capability by 300 ft.

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
360	%N1	90.9	96.3								
	MACH	.602	.664								
	KIAS	334	337								
	FF/ENG	10070	10778								
340	%N1	89.9	94.9	97.6							
	MACH	.602	.664	.683							
	KIAS	334	337	335							
	FF/ENG	9696	10338	10505							
320	%N1	88.7	92.9	94.8	97.7						
	MACH	.602	.653	.670	.689						
	KIAS	334	332	328	325						
	FF/ENG	9267	9589	9644	9735						
300	%N1	86.8	91.0	92.7	94.7	97.9					
	MACH	.592	.638	.657	.674	.694					
	KIAS	329	324	321	317	315					
	FF/ENG	8693	8874	8919	8944	9073					
280	%N1	85.0	89.2	90.8	92.6	94.8	98.3				
	MACH	.574	.622	.641	.660	.677	.700				
	KIAS	319	315	313	310	306	305				
	FF/ENG	8068	8218	8264	8284	8332	8544				
260	%N1	82.9	87.2	88.8	90.5	92.3	94.7	98.4			
	MACH	.557	.605	.623	.643	.662	.679	.704			
	KIAS	309	306	304	302	299	295	294			
	FF/ENG	7484	7593	7619	7642	7676	7747	8011			
240	%N1	80.8	84.8	86.8	88.3	90.0	91.8	94.5	98.3		
	MACH	.540	.585	.605	.624	.644	.663	.681	.707		
	KIAS	299	296	295	293	291	288	284	283		
	FF/ENG	6926	6949	7005	7013	7041	7088	7163	7427		
220	%N1	78.6	82.5	84.2	86.1	87.7	89.4	91.2	93.8	97.8	
	MACH	.522	.564	.584	.604	.623	.644	.663	.681	.708	
	KIAS	289	285	284	283	281	279	276	272	272	
	FF/ENG	6372	6314	6372	6413	6419	6456	6501	6563	6820	
200	%N1	76.2	79.9	81.7	83.4	85.3	86.9	88.6	90.4	93.0	96.9
	MACH	.503	.543	.561	.581	.601	.621	.642	.661	.680	.706
	KIAS	278	274	272	271	270	268	267	264	260	260
	FF/ENG	5827	5717	5752	5795	5829	5836	5870	5906	5957	6195
180	%N1	73.8	77.2	78.9	80.7	82.3	84.2	85.8	87.5	89.3	91.9
	MACH	.484	.521	.538	.556	.575	.596	.616	.638	.658	.677
	KIAS	268	263	261	259	258	257	256	254	251	248
	FF/ENG	5301	5135	5167	5198	5215	5244	5254	5279	5309	5352
160	%N1	71.0	74.3	76.0	77.6	79.3	81.0	82.7	84.5	86.1	88.0
	MACH	.464	.498	.514	.530	.548	.567	.589	.609	.631	.652
	KIAS	257	251	249	247	246	244	243	242	240	238
	FF/ENG	4797	4574	4596	4632	4637	4636	4658	4673	4689	4716

ENGINE INOP

MAX CONTINUOUS THRUST

**Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
284	263	244	227	213	200	190	181	173	166	159
565	523	485	453	425	400	381	364	348	334	321
847	784	728	680	638	600	572	546	522	501	482
1129	1045	970	906	850	800	763	729	698	669	643
1413	1308	1214	1133	1063	1000	954	911	872	836	804
1697	1570	1457	1361	1276	1200	1145	1094	1047	1004	965
1982	1834	1701	1588	1489	1400	1336	1276	1221	1171	1125
2268	2097	1945	1815	1702	1600	1526	1458	1395	1338	1286
2554	2362	2190	2043	1915	1800	1717	1640	1569	1505	1446
2842	2626	2434	2270	2128	2000	1908	1822	1743	1671	1606

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	3.8	0:39	3.3	0:38	3.0	0:36	2.7	0:36	2.5	0:35
400	8.0	1:13	7.3	1:10	6.8	1:08	6.4	1:05	6.1	1:03
600	12.1	1:48	11.2	1:44	10.6	1:39	10.0	1:35	9.7	1:32
800	16.2	2:23	15.1	2:17	14.3	2:11	13.6	2:06	13.2	2:01
1000	20.2	2:59	18.9	2:50	18.0	2:43	17.1	2:36	16.7	2:30
1200	24.2	3:34	22.7	3:24	21.7	3:15	20.7	3:06	20.2	2:59
1400	28.2	4:10	26.5	3:58	25.3	3:47	24.1	3:37	23.6	3:29
1600	32.1	4:46	30.2	4:33	28.9	4:19	27.6	4:08	26.9	3:58
1800	36.0	5:22	33.8	5:07	32.4	4:52	31.0	4:39	30.2	4:28
2000	39.8	5:59	37.5	5:42	36.0	5:25	34.4	5:10	33.5	4:58

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)										
	150	170	190	210	230	250	270	290	310	330	350
5	-1.0	-0.8	-0.6	-0.4	-0.2	0.0	0.3	0.7	1.1	1.7	2.4
10	-2.1	-1.7	-1.3	-0.9	-0.4	0.0	0.7	1.5	2.5	3.7	5.0
15	-3.3	-2.6	-2.0	-1.3	-0.7	0.0	1.0	2.3	3.8	5.6	7.6
20	-4.4	-3.5	-2.7	-1.8	-0.9	0.0	1.4	3.1	5.1	7.4	9.9
25	-5.5	-4.4	-3.4	-2.2	-1.1	0.0	1.8	3.9	6.3	9.1	12.2
30	-6.7	-5.4	-4.0	-2.7	-1.3	0.0	2.1	4.6	7.5	10.7	14.3
35	-7.8	-6.3	-4.7	-3.2	-1.6	0.0	2.5	5.3	8.6	12.2	16.2
40	-8.9	-7.2	-5.4	-3.6	-1.8	0.0	2.8	6.0	9.7	13.7	18.1

Includes APU fuel burn.

ENGINE INOP
MAX CONTINUOUS THRUST

**Holding
Flaps Up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
360	%N1	80.5	83.9	88.6	93.4			
	KIAS	264	264	265	269			
	FF/ENG	9070	9130	9370	9670			
340	%N1	78.7	81.9	86.7	91.4	100.4		
	KIAS	260	260	260	260	299		
	FF/ENG	8520	8560	8730	8950	10320		
320	%N1	76.7	79.7	84.6	89.2	96.4		
	KIAS	253	253	253	253	289		
	FF/ENG	7930	7940	8050	8210	9240		
300	%N1	74.7	77.7	82.3	87.1	92.4		
	KIAS	244	244	244	244	259		
	FF/ENG	7380	7360	7430	7550	8120		
280	%N1	72.8	75.7	80.1	85.0	90.1		
	KIAS	238	238	238	238	238		
	FF/ENG	6880	6850	6880	6950	7350		
260	%N1	70.7	73.6	77.8	82.8	87.8	95.1	
	KIAS	229	229	229	229	229	262	
	FF/ENG	6380	6340	6330	6380	6690	7470	
240	%N1	68.5	71.5	75.6	80.3	85.4	90.5	
	KIAS	223	223	223	223	223	228	
	FF/ENG	5910	5870	5820	5850	6110	6420	
220	%N1	66.2	69.1	73.2	77.7	82.8	87.7	96.7
	KIAS	217	217	217	217	217	217	242
	FF/ENG	5440	5400	5330	5350	5530	5760	6550
200	%N1	64.1	66.7	71.0	75.3	80.1	85.0	91.2
	KIAS	217	217	217	217	217	217	226
	FF/ENG	5010	4970	4910	4900	5040	5200	5550
180	%N1	62.0	64.6	68.6	72.9	77.6	82.5	87.2
	KIAS	217	217	217	217	217	217	217
	FF/ENG	4630	4580	4520	4500	4630	4730	4880
160	%N1	59.9	62.6	66.3	70.7	75.2	80.0	84.7
	KIAS	217	217	217	217	217	217	217
	FF/ENG	4300	4240	4160	4140	4250	4340	4450

This table includes 5% additional fuel for holding in a racetrack pattern.

ENGINE INOP

ADVISORY INFORMATION

**Gear Down Landing Rate of Climb Available
Flaps 20**

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	720	630				
50	780	680	520			
48	830	740	570			
46	880	790	620	480		
44	930	840	670	520		
42	980	900	730	570	420	
40	1020	950	770	620	460	
38	1030	1000	820	660	490	280
36	1030	1030	860	700	520	310
34	1040	1040	910	740	560	340
32	1040	1040	950	780	590	370
30	1050	1040	960	810	630	400
20	1080	1070	980	860	730	530
10	1100	1090	970	850	510	320
0	1120	1110	920	710	500	250
-20	1170	1150	960	740	520	260
-40	1220	1200	990	770	540	270

Rate of climb capability shown is valid for 190000 kg, gear down at VREF20 + 5.

Decrease rate of climb 50 ft/min per 5000 kg greater than 190000 kg.

Increase rate of climb 60 ft/min per 5000 kg less than 190000 kg.

Flaps 30

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	100	10				
50	150	60	-80			
48	200	110	-30			
46	240	160	20	-110		
44	290	210	70	-70		
42	340	260	110	-20	-160	
40	380	310	160	20	-130	
38	380	350	200	50	-100	-300
36	380	390	240	90	-70	-270
34	390	390	280	130	-40	-250
32	390	390	310	160	-10	-220
30	390	390	330	190	20	-200
20	410	400	340	240	110	-80
10	420	410	290	150	10	-150
0	430	420	260	80	-120	-360
-20	450	440	270	80	-120	-370
-40	470	460	280	90	-130	-390

Rate of climb capability shown is valid for 190000 kg, gear down at VREF30 + 5.

Decrease rate of climb 30 ft/min per 5000 kg greater than 190000 kg.

Increase rate of climb 40 ft/min per 5000 kg less than 190000 kg.

Intentionally
Blank

Performance Inflight

Alternate Mode EEC

Chapter PI

Section 44

ALTERNATE MODE EEC

Alternate Mode EEC Max Takeoff %N1

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)											
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	8400
55	131	95.7	96.0	96.2	96.1	96.0	96.1	96.1	96.1	96.1	95.5	94.6	94.2
50	122	97.1	97.5	98.0	97.6	97.3	97.4	97.5	97.5	97.4	96.8	95.9	95.6
45	113	98.5	98.9	99.4	99.1	98.8	98.7	98.8	98.8	98.7	98.2	97.3	96.9
40	104	99.6	100.2	100.9	100.4	100.2	100.0	99.9	100.0	99.9	99.4	98.6	98.2
35	95	99.3	100.8	102.8	102.3	101.8	101.4	101.2	101.3	101.0	100.4	99.6	99.3
30	86	98.5	99.9	102.7	104.0	104.0	103.8	103.4	103.4	102.6	101.5	100.7	100.3
25	77	97.7	99.1	101.8	103.1	104.4	105.5	105.8	106.3	105.3	103.8	102.4	101.8
20	68	96.9	98.3	101.0	102.3	103.5	104.6	105.8	106.8	106.8	105.9	104.8	104.3
15	59	96.0	97.4	100.1	101.4	102.6	103.7	104.9	105.9	106.4	106.1	105.6	105.3
10	50	95.2	96.6	99.2	100.5	101.7	102.8	103.9	105.0	105.5	105.2	104.9	104.8
5	41	94.4	95.7	98.4	99.6	100.8	101.9	103.0	104.1	104.5	104.2	104.0	103.8
0	32	93.5	94.9	97.5	98.7	99.9	101.0	102.1	103.1	103.6	103.3	103.0	102.9
-10	14	91.8	93.1	95.7	96.9	98.1	99.1	100.2	101.2	101.7	101.4	101.1	101.0
-20	-4	90.0	91.3	93.8	95.0	96.2	97.2	98.3	99.3	99.7	99.4	99.2	99.0
-30	-22	88.2	89.5	92.0	93.1	94.3	95.3	96.3	97.3	97.7	97.5	97.2	97.1
-40	-40	86.4	87.6	90.1	91.2	92.3	93.3	94.3	95.3	95.7	95.4	95.2	95.1
-50	-58	84.5	85.7	88.1	89.2	90.3	91.3	92.3	93.2	93.6	93.4	93.1	93.0

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)											
	-2	-1	0	1	2	3	4	5	6	7	8	8.4
PACKS OFF	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3
WING ANTI-ICE ON	-0.2	-0.3	-0.4	-0.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4

Intentionally
Blank

Performance Inflight**Gear Down****Chapter PI****Section 45****GEAR DOWN****220 KIAS Max Climb %N1**

TAT (°C)	PRESSURE ALTITUDE (1000 FT)														
	0	5	10	12	14	16	18	20	22	24	26	28	30	32	34
55	88.2	88.3	91.4	91.1	92.1	91.3	94.0	95.2	95.4	98.1	99.9	101.1	102.4	102.9	103.4
50	89.5	88.8	90.7	90.4	91.4	92.1	93.3	94.5	94.7	97.3	99.2	100.3	101.6	102.1	102.6
45	90.5	90.1	90.0	89.7	90.7	91.4	92.6	93.8	93.9	96.6	98.4	99.6	100.8	101.3	101.8
40	91.6	91.2	91.2	89.7	89.9	90.7	91.9	93.0	93.2	95.8	97.6	98.8	100.0	100.5	101.0
35	92.6	92.3	92.2	92.1	90.6	89.9	91.1	92.3	92.5	95.0	96.8	98.0	99.2	99.7	100.2
30	93.0	93.2	93.2	93.0	92.2	91.2	90.9	91.5	91.7	94.3	96.0	97.2	98.4	98.9	99.4
25	92.2	94.2	94.1	94.0	93.7	92.8	92.1	92.0	91.1	93.5	95.2	96.4	97.6	98.0	98.5
20	91.4	94.2	95.1	95.0	94.9	94.4	93.4	93.0	92.8	93.6	94.4	95.6	96.8	97.2	97.7
15	90.7	93.4	96.7	96.4	96.3	96.1	94.8	94.1	94.5	94.8	95.2	95.3	96.0	96.4	96.9
10	89.9	92.6	96.3	97.9	98.1	98.1	96.8	95.5	96.5	96.2	96.4	96.4	96.6	96.1	96.0
5	89.1	91.7	95.4	97.1	98.9	100.3	99.0	97.9	98.2	97.8	97.8	97.9	97.9	97.3	96.8
0	88.3	90.9	94.6	96.2	98.0	100.1	100.8	100.3	100.1	99.7	99.4	99.4	99.5	98.6	98.1
-5	87.4	90.1	93.7	95.3	97.1	99.1	99.9	100.8	101.9	101.5	101.1	101.1	101.1	100.2	99.6
-10	86.6	89.2	92.8	94.4	96.1	98.2	98.9	99.8	101.4	102.8	102.6	102.6	103.0	101.6	100.8
-15	85.8	88.4	91.9	93.5	95.2	97.3	98.0	98.9	100.4	101.8	102.5	103.2	103.8	102.5	101.4
-20	85.0	87.5	91.1	92.6	94.3	96.3	97.0	97.9	99.4	100.8	101.5	102.2	103.3	102.4	101.3

Anti-ice Adjustment

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)							
	0	5	10	15	20	25	30	35
2 PACKS ON - 1 BLEED SOURCE	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4
1 PACK ON - 1 OR 2 BLEED SOURCES	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4
ENGINE ANTI-ICE ON	-0.3	-0.5	-0.4	-0.3	-0.1	-0.2	-0.2	-0.2
ENGINE AND WING ANTI-ICE ON*	-0.6	-0.8	-0.7	-0.5	-0.2	-0.3	-0.3	-0.4
ENGINE AND WING ANTI-ICE ON**	-1.1	-0.9	-0.9	-0.6	-0.3	-0.4	-0.5	-0.5

* Packs on or off with 2 bleed sources.

** Packs off with 1 bleed source.

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
360	18500	16600	14200
350	19200	17300	14800
340	19700	18000	15500
330	20600	18900	16300
320	21700	20100	17600
310	22800	21300	19000
300	23900	22400	20300
290	25000	23500	21800
280	26000	24600	23000
270	27100	25900	24300
260	28200	27200	25700
250	29400	28600	27100
240	30400	30000	28500
230	31200	30800	29900
220	32000	31700	31000
210	32800	32600	32000
200	33500	33200	32700
190	34000	33900	33400
180	34600	34500	34100
170	35200	35100	34700
160	35800	35700	35300

GEAR DOWN**Long Range Cruise Control**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
360	%N1	84.4	88.7	90.7	93.0						
	MACH	.488	.535	.556	.578						
	KIAS	270	270	270	270						
	FF/ENG	7524	7653	7775	7993						
340	%N1	83.5	87.8	89.7	91.8						
	MACH	.488	.535	.556	.578						
	KIAS	270	270	270	270						
	FF/ENG	7296	7405	7486	7646						
320	%N1	82.6	86.7	88.3	90.0	92.1					
	MACH	.488	.534	.550	.568	.588					
	KIAS	270	269	267	265	264					
	FF/ENG	7058	7105	7101	7142	7267					
300	%N1	81.2	84.9	86.6	88.2	89.9	92.1				
	MACH	.481	.520	.537	.554	.572	.594				
	KIAS	266	262	260	258	257	256				
	FF/ENG	6725	6632	6624	6623	6679	6806				
280	%N1	79.3	83.1	84.9	86.4	87.9	89.7	92.3			
	MACH	.468	.507	.523	.540	.557	.576	.598			
	KIAS	259	255	253	252	250	248	248			
	FF/ENG	6283	6189	6167	6168	6164	6230	6361			
260	%N1	77.2	81.1	82.9	84.6	86.0	87.6	89.4	92.3	96.7	
	MACH	.453	.492	.508	.525	.542	.559	.579	.602	.628	
	KIAS	251	248	246	244	243	241	239	239	239	
	FF/ENG	5831	5754	5724	5709	5711	5706	5778	5910	6239	
240	%N1	75.0	79.0	80.8	82.4	84.1	85.5	87.1	89.0	92.0	
	MACH	.438	.476	.492	.508	.525	.543	.561	.581	.605	
	KIAS	242	240	238	237	235	233	231	230	230	
	FF/ENG	5377	5317	5292	5266	5254	5253	5252	5320	5450	
220	%N1	72.6	76.7	78.4	80.2	81.7	83.4	84.9	86.4	88.4	91.5
	MACH	.421	.459	.475	.491	.508	.525	.543	.561	.582	.606
	KIAS	232	231	230	228	227	225	224	222	221	220
	FF/ENG	4925	4872	4859	4836	4811	4800	4799	4799	4859	4983
200	%N1	69.9	74.1	75.8	77.5	79.3	80.9	82.7	84.4	86.3	88.5
	MACH	.403	.441	.456	.473	.489	.506	.526	.548	.571	.596
	KIAS	223	221	220	219	218	217	217	216	217	217
	FF/ENG	4476	4425	4418	4408	4384	4360	4387	4432	4481	4565
180	%N1	67.8	72.2	74.1	75.9	77.9	79.8	81.5	83.3	85.1	87.0
	MACH	.392	.431	.448	.466	.485	.505	.526	.548	.571	.596
	KIAS	217	217	217	217	217	217	217	216	217	217
	FF/ENG	4152	4138	4141	4159	4170	4182	4208	4249	4283	4335
160	%N1	66.8	71.3	73.1	74.9	76.9	78.7	80.5	82.4	84.1	85.9
	MACH	.392	.431	.448	.466	.485	.505	.526	.548	.571	.596
	KIAS	217	217	217	217	217	217	217	216	217	217
	FF/ENG	4013	3995	3994	4006	4019	4031	4053	4088	4125	4159

GEAR DOWN

**Long Range Cruise Enroute Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
310	280	254	233	216	200	189	179	170	162	155
622	562	510	467	431	400	378	358	340	324	311
936	845	766	702	648	600	567	538	511	487	466
1253	1131	1024	937	864	800	757	718	682	650	621
1573	1418	1283	1173	1081	1000	946	897	852	812	776
1896	1706	1542	1409	1298	1200	1135	1076	1022	973	930
2222	1997	1803	1646	1515	1400	1324	1254	1191	1134	1084
2552	2291	2066	1884	1733	1600	1513	1433	1361	1296	1238
2883	2586	2329	2122	1951	1800	1702	1612	1530	1457	1392
3215	2881	2593	2361	2169	2000	1890	1790	1699	1618	1545
3547	3177	2857	2600	2387	2200	2079	1968	1868	1778	1699
3880	3472	3120	2838	2604	2400	2268	2147	2038	1940	1853
4213	3768	3384	3076	2822	2600	2457	2326	2207	2101	2007
4545	4063	3648	3315	3040	2800	2646	2505	2377	2262	2161
4878	4359	3912	3554	3258	3000	2835	2683	2546	2424	2315
5211	4655	4176	3792	3476	3200	3023	2862	2716	2585	2468
5544	4951	4440	4031	3694	3400	3212	3041	2885	2746	2622
5876	5246	4703	4269	3912	3600	3401	3220	3055	2907	2776
6209	5541	4967	4507	4130	3800	3590	3398	3224	3068	2930
6542	5837	5230	4746	4348	4000	3778	3576	3393	3229	3084

Reference Fuel and Time Required at Check Point

AIR DIST(NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME	FUEL	TIME
	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)	1000 KG	(HR:MIN)
200	7.4	0:46	6.7	0:44	5.8	0:42	5.3	0:41	5.0	0:39
400	15.0	1:29	13.9	1:25	12.4	1:20	11.6	1:17	11.1	1:13
600	22.6	2:13	21.1	2:06	19.0	1:58	17.9	1:53	17.2	1:48
800	30.0	2:57	28.0	2:48	25.4	2:37	24.0	2:30	23.0	2:23
1000	37.3	3:42	34.9	3:30	31.8	3:15	30.1	3:07	28.9	2:57
1200	44.4	4:28	41.6	4:14	38.0	3:55	35.9	3:44	34.5	3:33
1400	51.5	5:14	48.3	4:57	44.1	4:35	41.8	4:22	40.1	4:09
1600	58.3	6:01	54.7	5:41	50.1	5:15	47.5	5:00	45.6	4:45
1800	65.1	6:49	61.2	6:26	56.1	5:56	53.1	5:38	51.0	5:21
2000	71.7	7:37	67.5	7:11	61.9	6:37	58.7	6:17	56.3	5:57
2200	78.3	8:25	73.7	7:56	67.7	7:18	64.2	6:55	61.6	6:33
2400	84.8	9:13	79.9	8:41	73.4	7:59	69.6	7:34	66.8	7:09
2600	91.3	10:00	86.0	9:26	79.1	8:40	75.0	8:12	72.0	7:45
2800	97.6	10:48	92.0	10:11	84.6	9:21	80.3	8:51	77.1	8:21
3000	104.0	11:36	98.0	10:56	90.2	10:02	85.6	9:29	82.1	8:57
3200	110.2	12:24	103.9	11:41	95.7	10:43	90.8	10:08	87.1	9:33
3400	116.5	13:12	109.8	12:27	101.1	11:24	96.0	10:46	92.1	10:09
3600	122.6	14:00	115.6	13:12	106.5	12:05	101.1	11:25	97.0	10:45
3800	128.7	14:48	121.4	13:57	111.9	12:46	106.2	12:03	101.9	11:21
4000	134.8	15:36	127.2	14:42	117.2	13:27	111.3	12:42	106.8	11:57

GEAR DOWN**Long Range Cruise Enroute Fuel and Time****Fuel Required Adjustment (1000 KG)**

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)											
	150	170	190	210	230	250	270	290	310	330	350	
10	-1.8	-1.6	-1.3	-0.9	-0.4	0.0	0.8	1.8	2.9	4.1	5.5	
20	-3.6	-3.2	-2.6	-1.8	-0.9	0.0	1.6	3.4	5.5	7.9	10.5	
30	-5.3	-4.7	-3.8	-2.7	-1.4	0.0	2.2	4.9	7.9	11.3	15.1	
40	-6.8	-6.0	-5.0	-3.5	-1.8	0.0	2.9	6.2	10.1	14.4	19.2	
50	-8.3	-7.3	-6.0	-4.2	-2.2	0.0	3.4	7.4	12.0	17.1	22.9	
60	-9.5	-8.4	-6.9	-4.9	-2.5	0.0	3.9	8.4	13.7	19.6	26.1	
70	-10.7	-9.5	-7.8	-5.5	-2.8	0.0	4.3	9.3	15.1	21.6	28.9	
80	-11.7	-10.4	-8.5	-6.1	-3.1	0.0	4.6	10.1	16.3	23.4	31.2	
90	-12.6	-11.2	-9.2	-6.5	-3.4	0.0	4.9	10.7	17.3	24.8	33.1	
100	-13.4	-11.9	-9.8	-7.0	-3.7	0.0	5.1	11.1	18.0	25.9	34.6	
110	-14.1	-12.5	-10.3	-7.3	-3.9	0.0	5.2	11.4	18.5	26.6	35.6	
120	-14.6	-12.9	-10.7	-7.6	-4.0	0.0	5.3	11.6	18.8	27.0	36.1	
130	-15.0	-13.3	-11.0	-7.9	-4.2	0.0	5.3	11.6	18.8	27.0	36.2	
140	-15.2	-13.5	-11.2	-8.1	-4.3	0.0	5.2	11.5	18.6	26.7	35.8	

Descent at VREF30 + 80

PRESSURE ALTITUDE (1000 FT)	17	19	21	23	25	27	29	31	33	35
DISTANCE (NM)	35	40	44	48	52	57	61	65	69	74
TIME (MINUTES)	11	12	13	14	15	15	16	17	18	18

GEAR DOWN

**Holding
Flaps Up**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
360	%N1	76.1						
	KIAS	264						
	FF/ENG	7750						
340	%N1	74.6	77.7					
	KIAS	260	260					
	FF/ENG	7360	7350					
320	%N1	72.8	75.8					
	KIAS	253	253					
	FF/ENG	6890	6870					
300	%N1	70.6	73.7	78.1				
	KIAS	244	244	244				
	FF/ENG	6380	6370	6340				
280	%N1	68.8	72.0	76.3				
	KIAS	238	238	238				
	FF/ENG	5970	5960	5920				
260	%N1	66.7	69.7	74.1	78.6			
	KIAS	229	229	229	229			
	FF/ENG	5520	5510	5470	5490			
240	%N1	64.9	67.7	72.2	76.7			
	KIAS	223	223	223	223			
	FF/ENG	5150	5130	5100	5100			
220	%N1	63.1	65.8	70.1	74.6	79.4		
	KIAS	217	217	217	217	217		
	FF/ENG	4800	4770	4730	4730	4770		
200	%N1	61.9	64.7	68.8	73.3	78.0	82.7	
	KIAS	217	217	217	217	217	217	
	FF/ENG	4610	4570	4520	4520	4550	4610	
180	%N1	61.0	63.8	67.8	72.2	76.9	81.5	86.0
	KIAS	217	217	217	217	217	217	217
	FF/ENG	4450	4410	4360	4350	4370	4420	4520
160	%N1	60.1	62.9	66.8	71.3	75.9	80.5	84.9
	KIAS	217	217	217	217	217	217	217
	FF/ENG	4320	4270	4210	4190	4210	4260	4350

This table includes 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN

**Holding
Flaps 1**

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
360	%N1	75.9	79.0	83.8	88.3	94.3
	KIAS	244	244	244	244	244
	FF/ENG	7660	7700	7690	7810	8200
340	%N1	74.3	77.4	82.1	86.8	91.8
	KIAS	240	240	240	240	240
	FF/ENG	7240	7260	7250	7350	7630
320	%N1	72.5	75.5	80.0	84.9	89.7
	KIAS	233	233	233	233	233
	FF/ENG	6770	6780	6770	6830	7040
300	%N1	70.3	73.4	77.8	82.9	87.6
	KIAS	224	224	224	224	224
	FF/ENG	6270	6270	6270	6320	6450
280	%N1	68.3	71.5	75.8	80.6	85.6
	KIAS	218	218	218	218	218
	FF/ENG	5840	5840	5820	5870	5980
260	%N1	66.0	69.1	73.5	78.1	83.3
	KIAS	209	209	209	209	209
	FF/ENG	5380	5370	5340	5400	5460
240	%N1	64.1	66.9	71.4	75.9	81.0
	KIAS	203	203	203	203	203
	FF/ENG	4980	4960	4930	4970	5020
220	%N1	62.0	64.7	69.0	73.6	78.4
	KIAS	197	197	197	197	197
	FF/ENG	4600	4570	4530	4550	4610
200	%N1	60.5	63.2	67.3	71.8	76.5
	KIAS	197	197	197	197	197
	FF/ENG	4350	4310	4260	4270	4310
180	%N1	59.1	61.8	65.8	70.3	74.9
	KIAS	197	197	197	197	197
	FF/ENG	4140	4100	4040	4050	4070
160	%N1	57.9	60.7	64.6	69.0	73.5
	KIAS	197	197	197	197	197
	FF/ENG	3970	3920	3860	3860	3860

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight

Gear Down, Engine INOP

Chapter PI

Section 46

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
320	307	254	5600	4400	2200
300	288	246	7700	6800	5300
280	269	238	9800	9100	8100
260	250	230	12100	11400	10300
240	230	223	14000	13500	12400
220	210	217	15900	15400	14400
200	191	216	17300	16700	15700
180	172	216	18500	18100	16900
160	153	216	19700	19400	18200

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
340	1800		
330	3300	1000	
320	4500	2700	
310	5700	4400	1900
300	6800	5700	3800
290	7800	7000	5300
280	8800	8100	6700
270	9800	9100	8100
260	11100	10400	9300
250	12100	11400	10300
240	13100	12500	11300
230	14000	13600	12400
220	15100	14600	13600
210	15900	15400	14400
200	16700	16100	15100
190	17400	16700	15800
180	18000	17500	16400
170	18700	18200	16900
160	19300	18900	17700

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)							
		5	7	9	11	13	15	17	19
300	%N1	94.3	96.8						
	MACH	.403	.418						
	KIAS	244	244						
	FF/ENG	12328	12507						
280	%N1	92.3	94.1	96.8					
	MACH	.393	.407	.422					
	KIAS	238	238	238					
	FF/ENG	11514	11566	11807					
260	%N1	90.5	91.6	93.6	96.4				
	MACH	.385	.393	.408	.423				
	KIAS	233	229	229	229				
	FF/ENG	10870	10626	10714	10945				
240	%N1	88.9	89.8	91.3	93.4	96.5			
	MACH	.379	.385	.397	.412	.428			
	KIAS	229	225	223	223	223			
	FF/ENG	10228	9966	9915	10023	10245			
220	%N1	86.6	88.0	89.1	90.9	93.1	96.4		
	MACH	.368	.377	.387	.401	.417	.433		
	KIAS	223	220	217	217	217	217		
	FF/ENG	9452	9309	9167	9222	9323	9542		
200	%N1	84.2	86.0	87.8	89.5	91.4	94.0	98.1	
	MACH	.358	.371	.385	.400	.415	.431	.448	
	KIAS	217	217	217	217	217	217	217	
	FF/ENG	8693	8698	8718	8773	8844	8956	9300	
180	%N1	82.9	84.7	86.7	88.4	90.2	92.3	95.5	100.2
	MACH	.358	.371	.385	.400	.415	.431	.448	.466
	KIAS	217	217	217	217	217	217	217	217
	FF/ENG	8330	8328	8342	8399	8458	8533	8740	9239
160	%N1	81.7	83.6	85.4	87.3	89.0	90.9	93.5	97.7
	MACH	.358	.371	.385	.400	.415	.431	.448	.466
	KIAS	217	217	217	217	217	217	217	217
	FF/ENG	8019	8011	8010	8058	8115	8168	8310	8670

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
165	145	129	118	108	100	95	90	84	78	73
332	295	263	238	218	200	187	175	165	155	147
500	444	396	358	327	300	280	262	246	233	221
669	593	528	477	436	400	374	350	329	310	294
837	742	661	597	545	500	467	437	410	387	367
1007	893	795	718	655	600	560	524	492	464	440
1177	1043	928	838	764	700	653	611	574	541	513
1347	1193	1061	958	873	800	746	698	655	618	586
1519	1344	1195	1078	983	900	839	785	737	695	659
1691	1496	1329	1198	1092	1000	933	873	819	772	731

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	6		8		10		12		14	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
100	4.0	0:27	3.8	0:26	3.5	0:26	3.4	0:25	3.3	0:25
200	8.2	0:51	7.8	0:50	7.5	0:49	7.3	0:48	7.2	0:47
300	12.3	1:15	11.8	1:14	11.4	1:12	11.1	1:10	11.1	1:09
400	16.4	1:40	15.8	1:38	15.3	1:36	14.9	1:33	14.9	1:30
500	20.5	2:04	19.7	2:02	19.1	1:59	18.7	1:56	18.7	1:53
600	24.5	2:29	23.6	2:27	22.9	2:23	22.5	2:19	22.4	2:15
700	28.5	2:53	27.5	2:51	26.7	2:46	26.1	2:42	26.0	2:37
800	32.5	3:18	31.3	3:16	30.4	3:10	29.8	3:05	29.6	2:59
900	36.4	3:43	35.1	3:40	34.1	3:34	33.4	3:28	33.2	3:22
1000	40.3	4:08	38.8	4:05	37.8	3:58	37.0	3:51	36.7	3:44

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	150	200	250	300	350
5	-0.8	-0.5	0.0	1.6	2.6
10	-1.8	-1.1	0.0	3.0	5.6
15	-2.8	-1.6	0.0	4.4	8.6
20	-3.7	-2.2	0.0	5.6	11.6
25	-4.5	-2.7	0.0	6.8	14.4
30	-5.4	-3.2	0.0	7.8	17.3
35	-6.2	-3.7	0.0	8.7	20.0
40	-7.0	-4.2	0.0	9.5	22.7
45	-7.7	-4.7	0.0	10.2	25.3

Includes APU fuel burn.

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)			
		1500	5000	10000	15000
340	%N1	95.5			
	KIAS	260			
	FF/ENG	14970			
320	%N1	93.4	97.2		
	KIAS	253	253		
	FF/ENG	13980	14120		
300	%N1	91.1	94.3		
	KIAS	244	244		
	FF/ENG	12970	12940		
280	%N1	89.3	92.3	98.8	
	KIAS	238	238	238	
	FF/ENG	12100	12090	12660	
260	%N1	86.8	90.0	94.8	
	KIAS	229	229	229	
	FF/ENG	11100	11180	11340	
240	%N1	84.6	88.0	92.2	
	KIAS	223	223	223	
	FF/ENG	10310	10380	10460	
220	%N1	82.3	85.7	90.0	96.4
	KIAS	217	217	217	217
	FF/ENG	9540	9590	9650	10020
200	%N1	80.8	84.2	88.6	94.0
	KIAS	217	217	217	217
	FF/ENG	9080	9130	9180	9400
180	%N1	79.6	82.9	87.5	92.3
	KIAS	217	217	217	217
	FF/ENG	8700	8750	8780	8960
160	%N1	78.6	81.7	86.4	90.9
	KIAS	217	217	217	217
	FF/ENG	8380	8420	8430	8580

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight**Text****Chapter PI****Section 47**

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer. In addition, sufficient inflight data is provided to complete a flight with the FMC inoperative. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General**FMC Takeoff Speeds**

FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. This typically occurs at full rated thrust and light weights and is shown in the Minimum Takeoff Weight tables provided in the Performance Dispatch Takeoff section. The options are to select a smaller flaps setting, use reduced takeoff thrust and/or add weight (fuel). Selecting derate thrust is the preferred method of reduced takeoff thrust as this will reduce the minimum control speeds.

Clearway and Stopway V1 Adjustments

Takeoff speed corrections are to be applied to V1 when using takeoff weights based on the use of clearway and stopway.

Adjust V1 by the amount shown in the table. The adjusted V1 must not exceed VR. If V1 is greater than VR, VR may be increased to equal V1. The resultant V2 will be increased by the same amount that VR was increased.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF Speeds

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver speeds. Using VREF as the basis for the schedule makes it variable as a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assume an engine failure at the critical point during the takeoff.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush depths greater than 13mm (0.5 inches) are not recommended because of possible airplane damage as a result of slush impingement on the airplane structure. The use of assumed temperature for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight is determined as follows:

- (1) Determine the dry field/obstacle limit weight for the takeoff flap setting.
- (2) Enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.
- (3) Adjust field length available for temperature by amount shown on chart.

(4) Enter the V1(MCG) Limit Weight table with the field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

(1) Determine takeoff speeds V1, VR and V2 for actual brake release weight using Takeoff Speeds from the Performance Dispatch chapter or from the FMC.

(2) If V1(MCG) limited, set $V1 = V1(MCG)$. If not limited by V1(MCG) considerations, enter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than V1(MCG), set $V1 = V1(MCG)$.

Slippery Runway

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on reversers operating and a 15 ft screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Go-Around %N1

To find Go-Around %N1 based on normal engine bleed for packs on and anti-ice off, enter the Go-Around %N1 table with airport pressure altitude and reported OAT or TAT and read %N1. %N1 adjustments are shown for engine bleeds for various conditions.

Max Climb %N1

This table shows Max Climb %N1 for a 310/.84 climb speed schedule, normal engine bleed for packs on and anti-ice off. Enter the table with airport pressure altitude and TAT and read %N1. %N1 adjustments are shown for anti-ice operation.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Body attitude and average %N1 information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome may also cause unreliable airspeed/Mach indications. Climb, cruise and descent information is based on the recommended turbulent air penetration speed schedule: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and above; maintain a minimum speed of 15 knots above the minimum maneuvering speed when below 0.82 Mach. This schedule provides ample protection from stall and high speed buffet, while also providing protection from exceeding structural limits.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Control

These tables provide target %N1, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude, .84 Mach approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .84/310/250 descent. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent at .84/310/250

Distance and time for descent are shown for a .84/310/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing Flaps 30 at the outer marker.

Holding

Target %N1, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the FMC optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed for the selected flap setting. Flaps 1 is based on VREF30 + 60 speed schedule. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read %N1, IAS and fuel flow per engine.

Advisory Information

Normal Configuration Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and slippery runways with good, medium, and poor reported braking action. Landing distances for slippery runways are 115% of the actual landing distances.

To use these tables, determine the reference landing distance for the selected braking configuration. Then adjust the reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers to obtain the actual landing distance.

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. If the surface is affected by water, snow, or ice, and the braking action is reported as "good", conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate "poor" data reflects runways covered with wet ice.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" braking action, the airplane may not be able to achieve these deceleration rates. In these cases, runway slope and inoperative reversers influence the stopping distance. Since it cannot be determined quickly when this becomes a factor, it is appropriate to add the effects of slope and inoperative reversers when using the autobrake system.

Non-Normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances and adjustments are provided for dry runways and runways with good, medium, and poor reported braking action.

Enter the table with the applicable non-normal configuration and read the normal approach speed. The reference landing distance is a reference distance from 50 ft above the threshold to stop based on a reference landing weight and speed at sea level, zero wind, and zero slope. Subsequent columns provide corrections for off-reference landing weight, altitude, wind, slope, and speed conditions. Each corrections is independently added to the reference landing distance. Landing distance includes the effects of max manual braking and reverse thrust.

For an engine inoperative autoland, check the rate of climb capability shown in Gear Down Landing Rate of Climb Available tables to ensure adequate climb performance.

Landing Climb Limit Weight

In the event an overweight landing is necessary and the fuel dump system is unavailable, landing climb limits should be checked if a Flaps 25 or 30 landing is planned. Enter the table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required. At weights exceeding those shown, plan a Flaps 20 landing.

Recommended Brake Cooling Schedule

Advisory information is provided to assist in avoiding problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Recommended Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind, at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the appropriate Event Adjusted Brake Energy Table (No Reverse Thrust or 2 Engine Reverse) with the reference brake energy per brake and the type of

braking used during landing (Max Manual, Max Auto, or Autobrake). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing. The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Brake Temperature Monitor System (BTMS) indications are also shown. If brake cooling is determined from the BTMS, the hottest brake indication 10 to 15 minutes after the airplane has come to a complete stop, or inflight with gear retracted, may be used to determine recommended cooling schedule by entering at the bottom of the chart. An EICAS advisory message, BRAKE TEMP, will appear when any brake registers 5.0 or higher on the EICAS indication and disappear as the hottest brake cools with an EICAS indication of 3.5. Note that even without an EICAS advisory message, brake cooling is recommended.

Engine Inoperative

Initial Max Continuous %N1

The Initial Max Continuous %N1 setting for use following an engine failure is shown. The table is based on the typical all engine cruise Mach number of .84 to provide a target %N1 setting at the start of driftdown. Once driftdown is established, the Max Continuous %N1 Table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Power setting is based on one engine operating with engine bleed for packs on or off and all anti-ice bleeds off. Enter the table with pressure altitude and IAS or Mach to read %N1.

It is desirable to maintain engine thrust level within the limits of the Max Cruise thrust rating. However, where thrust level in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/Cruise Range Capability

This table shows the range capability from the start of driftdown.

Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to long range cruise speed. Cruise is continued at level off altitude and long range cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and correct for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required. If altitudes other than the level off altitude is used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

Table show the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on LRC speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target %N1, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (KG/HR)				
	GROSS WEIGHT (1000 KG)				
	300	260	220	180	140
43				160	140
39			180	160	145
35		200	190	170	140
31	230	220	195	165	140
25	230	220	195	175	155
20	235	230	205	185	165
15	235	235	215	200	185
10	240	240	230	220	200
5	270	270	255	240	220

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on single engine Long Range Cruise speed and .84/310/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion Table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the off reference fuel corrections table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down Landing Rate of Climb Available

Rate of climb data is provided as guidance information in the event an engine inoperative autoland is planned. The tables show gear down rate of climb available for Flaps 20 and Flaps 30. Enter the table with TAT and pressure altitude to read rate of climb available. Apply adjustments shown to correct for weight.

Alternate Mode EEC

No takeoff speed adjustments or other performance adjustments are required for operation of EEC in the ALTERNATE mode. Power setting adjustments are only required for the takeoff thrust rating.

Max Takeoff %N1

Takeoff power settings are presented for normal air condition bleed. Max Takeoff %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode and maximum rated thrust is reached at a thrust lever position less than full forward. As a result, thrust overboost can occur at full forward thrust lever positions.

Gear Down

This section contains performance for airplane operation with the landing gear extended for all phases of flight. The data is based on engine bleeds for normal air conditioning.

Note: The Flight Management Computer System (FMCS) does not contain special provisions for operation with landing gear extended. As a result, the FMCS will generate inaccurate enroute speed schedules, display non-conservative predictions of fuel burn, estimated time of arrival (ETA), maximum altitude, and compute overly shallow descent path. To obtain accurate ETA predictions, gear down cruise speed and altitude should be entered on the CLB and CRZ pages. Gear down cruise speed should also be entered on the DES page and a STEP SIZE of zero should be entered on the PERF INIT or CRZ page. Use of VNAV during descent under these circumstances is not recommended.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

Intentionally
Blank

Performance Inflight**Chapter PI****Table of Contents****Section 50****777-300 PW4090 LB FAA**

General	PI.50.1
Maximum Allowable Clearway	PI.50.1
Clearway and Stopway V1 Adjustments	PI.50.1
VREF	PI.50.2
Flap Maneuver Speed	PI.50.3
Slush/Standing Water Takeoff	PI.50.4
Slippery Runway Takeoff	PI.50.7
TO1 Slush/Standing Water Takeoff	PI.50.11
TO1 Slippery Runway Takeoff	PI.50.13
TO2 Slush/Standing Water Takeoff	PI.50.17
TO2 Slippery Runway Takeoff	PI.50.19
Minimum Control Speeds	PI.50.23
Go-around EPR	PI.50.24
Max Climb EPR	PI.50.25
Flight With Unreliable Airspeed / Turbulent Air Penetration	PI.50.26
All Engine	PI.51.1
Long Range Cruise Maximum Operating Altitude	PI.51.1
Long Range Cruise Control	PI.51.3
Long Range Cruise Enroute Fuel and Time - Low Altitude	PI.51.4
Long Range Cruise Enroute Fuel and Time - High Altitude	PI.51.6
Long Range Cruise Wind-Altitude Trade	PI.51.7
Descent at .84/310/250	PI.51.7
Holding	PI.51.8
Advisory Information	PI.52.1
Normal Configuration Landing Distance	PI.52.1
Non-Normal Configuration Landing Distance	PI.52.4
Landing Climb Limit Weight	PI.52.8
Recommended Brake Cooling Schedule	PI.52.9

Engine Inoperative PI.53.1

Initial Max Continuous EPR.....	PI.53.1
Max Continuous EPR.....	PI.53.2
Driftdown Speed/Level Off Altitude.....	PI.53.6
Driftdown/LRC Cruise Range Capability.....	PI.53.7
Long Range Cruise Altitude Capability.....	PI.53.8
Long Range Cruise Control.....	PI.53.9
Long Range Cruise Diversion Fuel and Time.....	PI.53.10
Holding.....	PI.53.12
Gear Down Landing Rate of Climb Available.....	PI.53.13

Alternate Mode EEC PI.54.1

Limit Weight.....	PI.54.1
Takeoff Speed Adjustment.....	PI.54.1
Max Takeoff %N1.....	PI.54.1
Max Climb %N1.....	PI.54.2
Max Cruise %N1.....	PI.54.2
Go-Around %N1.....	PI.54.3

Alternate Mode EEC, Engine Inoperative PI.55.1

Initial Max Continuous %N1.....	PI.55.1
Max Continuous %N1.....	PI.55.2

Gear Down..... PI.56.1

220 KIAS Max Climb EPR.....	PI.56.1
Long Range Cruise Altitude Capability.....	PI.56.2
Long Range Cruise Control.....	PI.56.3
Long Range Cruise Enroute Fuel and Time.....	PI.56.4
Descent at VREF30+80.....	PI.56.5
Holding.....	PI.56.6

Gear Down, Engine Inoperative PI.57.1

Driftdown Speed/Level Off Altitude.....	PI.57.1
Long Range Cruise Altitude Capability.....	PI.57.1
Long Range Cruise Control.....	PI.57.2

777 Flight Crew Operations Manual

Long Range Cruise Diversion Fuel and Time	PI.57.3
Holding	PI.57.4
Text	PI.58.1
Introduction	PI.58.1
General	PI.58.1
All Engines	PI.58.4
Advisory Information	PI.58.6
Engine Inoperative	PI.58.8
Alternate Mode EEC	PI.58.11
Alternate Mode EEC, Engine Inoperative	PI.58.12
Gear Down	PI.58.12

Intentionally
Blank

Performance Inflight
General

Chapter PI
Section 50

Maximum Allowable Clearway

FIELD LENGTH (FT)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (FT)
4000	400
6000	550
8000	650
10000	750
12000	850
14000	950
16000	1050

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (FT)	NORMAL V1 (KIAS)				
	100	120	140	160	180
600	-1	-1	-1	-1	-1
400	0	0	-1	-1	-1
200	0	0	0	0	0
0	0	0	0	0	0
-200	4	3	3	2	1
-400	5	4	3	2	1
-600	6	5	4	3	2
-800	6	6	5	4	2

VREF

WEIGHT (1000 LB)	FLAPS		
	30	25	20
660	169	174	183
640	165	172	181
620	163	169	178
600	160	167	175
580	157	164	172
560	155	161	169
540	152	158	166
520	149	155	163
500	146	152	160
480	143	149	157
460	140	146	154
440	137	143	150
420	133	139	147
400	130	136	143
380	126	132	139
360	123	128	135
340	119	124	131

Flap Maneuver Speed

FLAP POSITION	MANEUVER SPEED
FLAPS 0	VREF30 + 80
FLAPS 1	VREF30 + 60
FLAPS 5	VREF30 + 40
FLAPS 15	VREF30 + 20
FLAPS 20	VREF30 + 20
FLAPS 25	VREF25
FLAPS 30	VREF30

ADVISORY INFORMATION

Slush/Standing Water Takeoff

Maximum Reverse Thrust

Weight Adjustment (1000 LB)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	-73.7	-84.1	-94.5	-85.8	-96.2	-106.6	-112.4	-122.8	-133.2
660	-72.0	-82.4	-92.8	-83.4	-93.8	-104.2	-108.1	-118.5	-128.9
620	-69.1	-79.5	-89.9	-79.6	-90.0	-100.4	-102.3	-112.7	-123.1
580	-65.1	-75.5	-85.9	-74.5	-84.9	-95.3	-94.8	-105.2	-115.6
540	-59.8	-70.2	-80.6	-68.1	-78.5	-88.9	-85.9	-96.3	-106.7
500	-53.4	-63.8	-74.2	-60.4	-70.8	-81.2	-75.4	-85.8	-96.2
460	-45.7	-56.1	-66.5	-51.4	-61.8	-72.2	-63.3	-73.7	-84.1
420	-36.9	-47.3	-57.7	-41.0	-51.4	-61.8	-49.7	-60.1	-70.5
380	-26.9	-37.3	-47.7	-29.3	-39.7	-50.1	-34.5	-44.9	-55.3

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5800				320.3			315.4		
6200							389.7	364.4	339.7
6600	359.2	332.9	306.7	399.0	372.3	346.0	469.8	442.1	415.3
7000	440.8	412.7	385.4	482.6	454.0	426.0	559.0	527.9	498.1
7400	529.9	499.1	469.3	572.8	541.7	511.6	661.0	625.0	590.9
7800	628.9	594.4	561.3	671.3	637.2	604.3	777.0	737.8	698.6
8200	740.6	702.2	664.4	777.2	741.7	706.1			
8600			778.5						

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -125ft/+125ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-17	-13	-9	-12	-8	-4	-2	2	6
620	-19	-15	-11	-13	-9	-5	-3	1	5
580	-21	-17	-13	-15	-11	-7	-4	0	4
540	-23	-19	-15	-18	-14	-10	-7	-3	1
500	-25	-21	-17	-20	-16	-12	-10	-6	-2
460	-27	-23	-19	-23	-19	-15	-13	-9	-5
420	-28	-24	-20	-24	-20	-16	-16	-12	-8
380	-28	-24	-20	-25	-21	-17	-19	-15	-11
340	-28	-24	-20	-26	-22	-18	-21	-17	-13

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slush/Standing Water Takeoff

No Reverse Thrust

Weight Adjustment (1000 LB)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	-103.0	-115.0	-127.0	-121.9	-133.9	-145.9	-154.2	-166.2	-178.2
660	-97.5	-109.5	-121.5	-114.7	-126.7	-138.7	-143.6	-155.6	-167.6
620	-91.4	-103.4	-115.4	-106.8	-118.8	-130.8	-132.2	-144.2	-156.2
580	-84.5	-96.5	-108.5	-98.2	-110.2	-122.2	-120.1	-132.1	-144.1
540	-77.0	-89.0	-101.0	-88.8	-100.8	-112.8	-107.2	-119.2	-131.2
500	-68.9	-80.9	-92.9	-78.6	-90.6	-102.6	-93.5	-105.5	-117.5
460	-60.0	-72.0	-84.0	-67.6	-79.6	-91.6	-79.1	-91.1	-103.1
420	-50.5	-62.5	-74.5	-55.9	-67.9	-79.9	-64.0	-76.0	-88.0
380	-40.3	-52.3	-64.3	-43.5	-55.5	-67.5	-48.1	-60.1	-72.1
340	-29.4	-41.4	-53.4	-30.3	-42.3	-54.3	-31.4	-43.4	-55.4

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
8200							268.7		
8600							377.1	268.7	
9000							492.1	377.1	268.7
9400				334.6			619.2	492.1	377.1
9800				476.5	334.6		761.0	619.2	492.1
10200	369.2			647.8	476.5	334.6		761.0	619.2
10600	624.9	369.2			647.8	476.5			761.0
11000		624.9	369.2			647.8			
11400			624.9						

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water adjustment.
2. Adjust field length available by -190 ft/+180 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slush/Standing Water Takeoff

No Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-30	-24	-18	-21	-15	-9	-7	-1	0
620	-33	-27	-21	-24	-18	-12	-9	-3	0
580	-36	-30	-24	-27	-21	-15	-12	-6	0
540	-39	-33	-27	-31	-25	-19	-15	-9	-3
500	-42	-36	-30	-35	-29	-23	-20	-14	-8
460	-45	-39	-33	-39	-33	-27	-25	-19	-13
420	-47	-41	-35	-43	-37	-31	-31	-25	-19
380	-49	-43	-37	-45	-39	-33	-36	-30	-24
340	-51	-45	-39	-47	-41	-35	-43	-37	-31

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slippery Runway Takeoff Maximum Reverse Thrust Weight Adjustments (1000 LB)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	0.0	-4.0	-8.0	-31.1	-35.1	-39.1	-67.5	-71.5	-75.5
660	0.0	-4.0	-8.0	-35.8	-39.8	-43.8	-68.9	-72.9	-76.9
620	-1.9	-5.9	-9.9	-38.8	-42.8	-46.8	-68.8	-72.8	-76.8
580	-5.8	-9.8	-13.8	-40.3	-44.3	-48.3	-67.1	-71.1	-75.1
540	-8.4	-12.4	-16.4	-40.0	-44.0	-48.0	-63.9	-67.9	-71.9
500	-9.6	-13.6	-17.6	-38.2	-42.2	-46.2	-59.1	-63.1	-67.1
460	-9.3	-13.3	-17.3	-34.7	-38.7	-42.7	-52.8	-56.8	-60.8
420	-7.6	-11.6	-15.6	-29.6	-33.6	-37.6	-45.0	-49.0	-53.0
380	-4.6	-8.6	-12.6	-22.9	-26.9	-30.9	-35.7	-39.7	-43.7

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
4600	424.1	304.8							
5000	590.2	494.7	386.0						
5400	730.2	648.4	559.5						
5800			703.3						
6200				397.2					
6600				517.4	397.2				
7000				642.2	517.4	397.2			
7400				771.0	642.2	517.4			
7800					771.0	642.2	321.8		
8200						771.0	383.8		
8600							449.5	340.2	
9000							520.4	403.0	
9400							598.0	470.1	358.7
9800							684.8	542.9	422.6
10200							778.6	623.0	491.3
10600								712.9	566.1
11000									648.8
11400									741.0

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -70ft/+70ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -100ft/+100ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -135ft/+135ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

**Slippery Runway Takeoff
Maximum Reverse Thrust
V1 Adjustments (KIAS)**

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-3	-1	1	-12	-10	-8	-25	-23	-21
620	-4	-2	0	-15	-13	-11	-28	-26	-24
580	-6	-4	-2	-17	-15	-13	-31	-29	-27
540	-8	-6	-4	-20	-18	-16	-35	-33	-31
500	-9	-7	-5	-22	-20	-18	-38	-36	-34
460	-10	-8	-6	-25	-23	-21	-41	-39	-37
420	-11	-9	-7	-26	-24	-22	-44	-42	-40
380	-12	-10	-8	-28	-26	-24	-46	-44	-42
340	-12	-10	-8	-29	-27	-25	-48	-46	-44

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slippery Runway Takeoff

No Reverse Thrust

Weight Adjustment (1000 LB)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	-7.4	-11.4	-15.4	-57.1	-61.1	-65.1	-100.6	-104.6	-108.6
660	-12.9	-16.9	-20.9	-60.0	-64.0	-68.0	-97.9	-101.9	-105.9
620	-17.1	-21.1	-25.1	-61.3	-65.3	-69.3	-94.4	-98.4	-102.4
580	-20.3	-24.3	-28.3	-61.2	-65.2	-69.2	-89.9	-93.9	-97.9
540	-22.2	-26.2	-30.2	-59.5	-63.5	-67.5	-84.5	-88.5	-92.5
500	-23.1	-27.1	-31.1	-56.2	-60.2	-64.2	-78.1	-82.1	-86.1
460	-22.7	-26.7	-30.7	-51.4	-55.4	-59.4	-70.9	-74.9	-78.9
420	-21.2	-25.2	-29.2	-45.1	-49.1	-53.1	-62.8	-66.8	-70.8
380	-18.6	-22.6	-26.6	-37.3	-41.3	-45.3	-53.7	-57.7	-61.7
340	-14.8	-18.8	-22.8	-28.0	-32.0	-36.0	-43.8	-47.8	-51.8

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5800	686.4	601.9	452.4						
6200			722.1						
8600				716.0	531.6				
9000					772.9	632.7			
12600							409.4		
13000							621.4	275.1	
13400								496.1	
13800								701.9	364.9
14200									580.3

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -90 ft/+80 ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -130 ft/+120 ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -200 ft/+190 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

**Slippery Runway Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)**

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-6	0	0	-19	-13	-7	-40	-34	-28
620	-8	-2	0	-23	-17	-11	-45	-39	-33
580	-10	-4	0	-26	-20	-14	-50	-44	-38
540	-12	-6	0	-30	-24	-18	-56	-50	-44
500	-15	-9	-3	-34	-28	-22	-61	-55	-49
460	-17	-11	-5	-38	-32	-26	-66	-60	-54
420	-19	-13	-7	-42	-36	-30	-72	-66	-60
380	-21	-15	-9	-46	-40	-34	-77	-71	-65
340	-24	-18	-12	-50	-44	-38	-81	-75	-69

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

10% Thrust Reduction

Maximum Reverse Thrust

Weight Adjustment (1000 LB)

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	-63.3	-72.0	-80.6	-74.6	-83.3	-91.9	-99.8	-108.4	-116.8
660	-62.1	-70.7	-79.0	-72.6	-80.9	-89.1	-95.0	-103.3	-111.5
620	-59.5	-67.8	-76.0	-69.0	-77.2	-85.5	-89.6	-97.9	-106.1
580	-56.0	-64.2	-72.5	-64.6	-73.0	-81.5	-83.9	-92.5	-101.1
540	-53.2	-61.7	-70.3	-61.1	-69.7	-78.8	-78.9	-88.1	-97.4
500	-50.5	-59.8	-69.1	-57.9	-67.2	-76.4	-73.6	-83.2	-93.0
460	-46.6	-56.3	-66.1	-52.9	-62.6	-72.3	-66.2	-76.0	-85.7
420	-40.1	-49.8	-59.6	-44.8	-54.6	-64.3	-55.0	-64.7	-74.4
380	-30.8	-40.6	-50.3	-34.0	-43.7	-53.5	-40.8	-50.5	-60.2

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5400							314.4		
5800				333.2			402.4	305.6	
6200	384.0			424.5	324.1		496.6	393.4	
6600	478.2	374.9		520.6	415.2	315.0	601.0	486.8	384.5
7000	580.1	468.4	365.9	623.0	510.7	406.0	721.1	590.0	477.1
7400	693.4	569.5	458.8	733.5	612.4	500.9		708.4	579.1
7800		681.4	559.0		722.3	601.9			695.8
8200			669.6			711.1			

1. Enter Weight Adjustment table with slush/standing water depth and TO1 dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -125ft/+125ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-13	-9	-4	-8	-3	1	3	7	12
620	-15	-11	-7	-9	-5	-1	2	6	11
580	-17	-13	-9	-11	-7	-3	0	5	9
540	-20	-15	-11	-14	-10	-5	-2	2	6
500	-22	-18	-14	-17	-13	-8	-6	-1	3
460	-24	-20	-16	-20	-16	-12	-9	-5	-1
420	-26	-22	-17	-22	-18	-14	-13	-9	-4
380	-27	-23	-18	-24	-19	-15	-17	-12	-8
340	-27	-23	-19	-24	-20	-16	-20	-16	-11

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

10% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 LB)

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	-102.5	-114.5	-126.5	-121.9	-133.9	-145.9	-155.8	-167.8	-179.8
660	-96.9	-108.9	-120.9	-114.6	-126.6	-138.6	-145.0	-157.0	-169.0
620	-91.0	-103.0	-115.0	-107.0	-119.0	-131.0	-133.8	-145.8	-157.8
580	-84.5	-96.5	-108.5	-98.7	-110.7	-122.7	-121.9	-133.9	-145.9
540	-77.2	-89.2	-101.2	-89.5	-101.5	-113.5	-109.3	-121.3	-133.3
500	-69.3	-81.3	-93.3	-79.6	-91.6	-103.6	-95.9	-107.9	-119.9
460	-60.6	-72.6	-84.6	-69.0	-81.0	-93.0	-81.8	-93.8	-105.8
420	-51.3	-63.3	-75.3	-57.5	-69.5	-81.5	-66.8	-78.8	-90.8
380	-41.3	-53.3	-65.3	-45.3	-57.3	-69.3	-51.1	-63.1	-75.1
340	-30.7	-42.7	-54.7	-32.4	-44.4	-56.4	-34.8	-46.8	-58.8

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
7800							345.5		
8200							477.7	345.5	
8600				346.6			631.3	477.7	345.5
9000				531.0	346.6			631.3	477.7
9400	551.9				531.0	346.6			631.3
9800		551.9				531.0			
10200			551.9						

1. Enter Weight Adjustment table with slush/standing water depth and TO1 dry field/obstacle limit weight to obtain slush/standing water adjustment.
2. Adjust field length available by -190 ft/+180 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-24	-18	-12	-15	-9	-3	-1	0	0
620	-27	-21	-15	-18	-12	-6	-3	0	0
580	-30	-24	-18	-21	-15	-9	-6	0	0
540	-33	-27	-21	-25	-19	-13	-9	-3	0
500	-36	-30	-24	-29	-23	-17	-14	-8	-2
460	-39	-33	-27	-33	-27	-21	-19	-13	-7
420	-41	-35	-29	-37	-31	-25	-25	-19	-13
380	-43	-37	-31	-39	-33	-27	-31	-25	-19
340	-45	-39	-33	-41	-35	-29	-37	-31	-25

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff

10% Thrust Reduction

Maximum Reverse Thrust

Weight Adjustment (1000 LB)

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	0.0	-3.7	-7.5	-23.9	-27.6	-31.4	-61.3	-65.1	-68.8
660	0.0	-3.7	-7.5	-29.1	-32.9	-36.6	-63.3	-67.0	-70.8
620	0.0	-3.7	-7.5	-33.7	-37.5	-41.2	-64.6	-68.3	-72.1
580	-2.3	-6.0	-9.8	-36.6	-40.4	-44.1	-64.3	-68.0	-71.8
540	-6.0	-9.8	-13.5	-37.8	-41.5	-45.3	-62.4	-66.1	-69.9
500	-8.3	-12.0	-15.8	-37.2	-40.9	-44.7	-58.8	-62.5	-66.3
460	-9.0	-12.7	-16.5	-34.9	-38.6	-42.4	-53.6	-57.3	-61.1
420	-8.2	-12.0	-15.7	-30.8	-34.6	-38.3	-46.8	-50.5	-54.2
380	-6.0	-9.7	-13.5	-25.0	-28.8	-32.5	-38.3	-42.0	-45.8

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
4200	361.3								
4600	550.9	443.0	317.4						
5000	705.0	615.7	516.5						
5400		762.4	676.1						
5800				390.6					
6200				518.3	390.6				
6600				651.0	518.3	390.6			
7000					651.0	518.3			
7400						651.0	333.4		
7800							399.6		
8200							470.4	353.0	
8600							547.4	420.3	307.3
9000							632.6	492.8	372.7
9400							728.4	572.0	441.4
9800								660.1	515.8
10200								758.1	597.4
10600									688.9

1. Enter Weight Adjustment table with reported braking action and TO1 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -70ft/+70ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -100ft/+100ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -135ft/+135ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
10% Thrust Reduction
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-4	-2	0	-11	-10	-8	-22	-20	-18
620	-5	-3	-2	-13	-11	-10	-25	-23	-21
580	-6	-4	-3	-15	-14	-12	-28	-26	-24
540	-7	-6	-4	-17	-16	-14	-31	-29	-27
500	-9	-7	-6	-20	-18	-17	-34	-33	-31
460	-10	-9	-7	-22	-21	-19	-38	-36	-34
420	-12	-10	-8	-25	-23	-21	-41	-39	-37
380	-13	-11	-9	-26	-24	-23	-43	-41	-39
340	-13	-11	-10	-27	-25	-24	-45	-43	-41

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff

10% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 LB)

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	-1.1	-5.1	-9.1	-50.9	-54.9	-58.9	-98.0	-102.0	-106.0
660	-7.0	-11.0	-15.0	-54.2	-58.2	-62.2	-95.4	-99.4	-103.4
620	-12.4	-16.4	-20.4	-56.8	-60.8	-64.8	-92.3	-96.3	-100.3
580	-16.5	-20.5	-24.5	-57.8	-61.8	-65.8	-88.2	-92.2	-96.2
540	-19.4	-23.4	-27.4	-57.1	-61.1	-65.1	-83.3	-87.3	-91.3
500	-21.0	-25.0	-29.0	-54.9	-58.9	-62.9	-77.4	-81.4	-85.4
460	-21.5	-25.5	-29.5	-51.0	-55.0	-59.0	-70.5	-74.5	-78.5
420	-20.6	-24.6	-28.6	-45.5	-49.5	-53.5	-62.7	-66.7	-70.7
380	-18.5	-22.5	-26.5	-38.3	-42.3	-46.3	-53.9	-57.9	-61.9
340	-15.2	-19.2	-23.2	-29.6	-33.6	-37.6	-44.3	-48.3	-52.3

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5400	683.1	588.7							
5800			721.8						
7800				594.3					
8200					674.4				
8600						736.4			
11800							450.2		
12200							672.8	307.8	
12600								541.4	
13000								757.8	
13400									403.5
									629.7

1. Enter Weight Adjustment table with reported braking action and TO1 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -90 ft/+80 ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -130 ft/+120 ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -200 ft/+190 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
10% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-5	0	0	-16	-10	-4	-34	-28	-22
620	-7	-1	0	-19	-13	-7	-39	-33	-27
580	-9	-3	0	-23	-17	-11	-44	-38	-32
540	-11	-5	0	-26	-20	-14	-49	-43	-37
500	-13	-7	-1	-29	-23	-17	-54	-48	-42
460	-15	-9	-3	-33	-27	-21	-59	-53	-47
420	-17	-11	-5	-37	-31	-25	-64	-58	-52
380	-18	-12	-6	-40	-34	-28	-69	-63	-57
340	-20	-14	-8	-44	-38	-32	-74	-68	-62

- 1. Obtain V1, VR and V2 for the actual weight.
- 2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

20% Thrust Reduction

Maximum Reverse Thrust

Weight Adjustment (1000 LB)

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	-53.0	-59.8	-66.7	-63.5	-70.4	-77.2	-87.2	-94.1	-101.0
660	-51.7	-58.6	-65.5	-61.5	-68.4	-75.3	-83.5	-90.4	-97.2
620	-50.5	-57.4	-64.2	-59.6	-66.5	-73.3	-79.8	-86.7	-93.4
580	-49.3	-55.8	-61.9	-57.1	-63.2	-69.3	-73.5	-79.6	-85.7
540	-44.0	-50.0	-56.1	-50.7	-56.8	-62.8	-65.4	-71.5	-78.2
500	-40.3	-47.1	-53.8	-46.9	-53.6	-60.3	-61.0	-68.5	-76.7
460	-41.5	-49.6	-57.7	-47.9	-56.0	-64.3	-61.6	-70.5	-79.6
420	-40.6	-49.6	-58.7	-46.1	-55.1	-64.2	-57.8	-66.8	-75.9
380	-34.3	-43.4	-52.4	-38.2	-47.3	-56.3	-46.5	-55.6	-64.6

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5000							312.9		
5400	311.7			351.0			420.3	301.9	
5800	417.0	300.9		458.3	340.3		532.6	409.5	
6200	525.7	406.4		568.6	447.5	329.4	656.1	521.0	398.7
6600	642.1	514.6	395.8	684.3	557.4	436.7		643.0	509.5
7000	767.5	630.0	503.5		672.4	546.2		778.2	630.1
7400		755.0	618.0			660.6			764.8
7800			742.5			779.0			

1. Enter Weight Adjustment table with slush/standing water depth and TO2 dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -125ft/+125ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-8	-3	2	-2	3	8	11	15	20
620	-10	-5	-1	-4	1	6	9	14	19
580	-13	-8	-3	-6	-1	4	7	12	17
540	-15	-10	-6	-9	-4	1	5	10	14
500	-18	-13	-8	-12	-7	-2	1	6	11
460	-20	-15	-11	-16	-11	-6	-3	1	6
420	-23	-18	-13	-19	-14	-9	-8	-4	1
380	-24	-19	-14	-20	-15	-10	-12	-7	-2
340	-24	-19	-14	-21	-16	-11	-15	-10	-5

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

20% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 LB)

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	-98.7	-110.7	-122.7	-118.4	-130.4	-142.4	-153.8	-165.8	-177.8
660	-93.5	-105.5	-117.5	-111.6	-123.6	-135.6	-143.5	-155.5	-167.5
620	-88.2	-100.2	-112.2	-104.7	-116.7	-128.7	-133.2	-145.2	-157.2
580	-82.9	-94.9	-106.9	-97.8	-109.8	-121.8	-122.8	-134.8	-146.8
540	-76.9	-88.9	-100.9	-90.0	-102.0	-114.0	-111.6	-123.6	-135.6
500	-70.1	-82.1	-94.1	-81.4	-93.4	-105.4	-99.5	-111.5	-123.5
460	-62.5	-74.5	-86.5	-71.8	-83.8	-95.8	-86.5	-98.5	-110.5
420	-54.1	-66.1	-78.1	-61.4	-73.4	-85.4	-72.5	-84.5	-96.5
380	-44.9	-56.9	-68.9	-50.0	-62.0	-74.0	-57.7	-69.7	-81.7
340	-34.8	-46.8	-58.8	-37.7	-49.7	-61.7	-42.0	-54.0	-66.0

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
7000							310.7		
7400							468.9	310.7	
7800				376.4			661.7	468.9	310.7
8200	336.9			632.5	376.4			661.7	468.9
8600	740.6	336.9			632.5	376.4			661.7
9000		740.6	336.9			632.5			
9400			740.6						

1. Enter Weight Adjustment table with slush/standing water depth and TO2 dry field/obstacle limit weight to obtain slush/standing water adjustment.
2. Adjust field length available by -190 ft/+180 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-15	-9	-3	-5	0	0	0	0	0
620	-19	-13	-7	-8	-2	0	0	0	0
580	-22	-16	-10	-13	-7	-1	0	0	0
540	-26	-20	-14	-17	-11	-5	0	0	0
500	-30	-24	-18	-22	-16	-10	-4	0	0
460	-33	-27	-21	-27	-21	-15	-10	-4	0
420	-36	-30	-24	-31	-25	-19	-16	-10	-4
380	-38	-32	-26	-34	-28	-22	-23	-17	-11
340	-40	-34	-28	-36	-30	-24	-31	-25	-19

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff

20% Thrust Reduction

Maximum Reverse Thrust

Weight Adjustment (1000 LB)

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	0.0	-3.4	-6.8	-15.1	-18.5	-21.8	-52.9	-56.3	-59.6
660	0.0	-3.4	-6.8	-20.3	-23.7	-27.1	-54.8	-58.2	-61.6
620	0.0	-3.4	-6.8	-25.6	-29.0	-32.4	-57.0	-60.4	-63.8
580	0.0	-3.4	-6.8	-30.6	-34.0	-37.4	-58.9	-62.3	-65.8
540	-2.3	-5.8	-9.2	-33.7	-37.2	-40.6	-59.0	-62.5	-66.0
500	-6.0	-9.4	-12.9	-34.9	-38.4	-41.9	-57.3	-60.8	-64.3
460	-8.0	-11.5	-14.9	-34.3	-37.8	-41.3	-53.8	-57.3	-60.9
420	-8.3	-11.9	-15.4	-31.7	-35.2	-38.7	-48.5	-52.0	-55.6
380	-7.1	-10.7	-14.2	-27.2	-30.8	-34.3	-41.4	-44.9	-48.5

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
4200	503.1	377.3							
4600	676.7	576.8	463.5						
5000		738.7	644.6						
5400				384.7					
5800				521.3	371.3				
6200				663.2	507.5	358.0			
6600					648.8	493.7			
7000						634.4	347.4		
7400						779.7	418.2		
7800							494.7	368.1	
8200							578.3	440.5	319.7
8600							671.8	518.9	389.3
9000							774.8	605.2	463.3
9400								702.5	543.8
9800									633.0
10200									733.5

1. Enter Weight Adjustment table with reported braking action and TO2 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -70ft/+70ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -100ft/+100ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -135ft/+135ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
20% Thrust Reduction
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-4	-3	-2	-10	-9	-7	-19	-17	-16
620	-5	-4	-2	-12	-10	-9	-21	-20	-18
580	-6	-5	-3	-13	-12	-11	-24	-22	-21
540	-7	-6	-4	-15	-14	-12	-27	-25	-23
500	-8	-7	-5	-17	-16	-14	-29	-28	-26
460	-9	-8	-7	-19	-18	-16	-33	-31	-29
420	-11	-10	-9	-22	-21	-19	-36	-35	-33
380	-12	-11	-9	-23	-22	-20	-38	-37	-35
340	-12	-11	-9	-24	-22	-21	-39	-38	-36

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff

20% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 LB)

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
700	0.0	0.0	-2.1	-43.0	-47.0	-51.0	-93.5	-97.5	-101.5
660	0.0	-4.0	-8.0	-46.4	-50.4	-54.4	-91.1	-95.1	-99.1
620	-5.9	-9.9	-13.9	-49.8	-53.8	-57.8	-88.5	-92.5	-96.5
580	-11.3	-15.3	-19.3	-52.5	-56.5	-60.5	-85.5	-89.5	-93.5
540	-15.4	-19.4	-23.4	-53.5	-57.5	-61.5	-81.5	-85.5	-89.5
500	-18.2	-22.2	-26.2	-52.7	-56.7	-60.7	-76.5	-80.5	-84.5
460	-19.7	-23.7	-27.7	-50.2	-54.2	-58.2	-70.4	-74.4	-78.4
420	-19.8	-23.8	-27.8	-45.9	-49.9	-53.9	-63.4	-67.4	-71.4
380	-18.5	-22.5	-26.5	-39.9	-43.9	-47.9	-55.2	-59.2	-63.2
340	-16.0	-20.0	-24.0	-32.1	-36.1	-40.1	-46.1	-50.1	-54.1

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5000	668.1	554.0							
5400			711.3						
7400				708.9					
7800					775.3	604.2			
11000							495.5		
11400							730.9	344.1	
11800								592.0	
12200									445.9
12600									685.2

1. Enter Weight Adjustment table with reported braking action and TO2 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -90 ft/+80 ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -130 ft/+120 ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -200 ft/+190 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
20% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
660	-6	0	0	-15	-9	-3	-30	-24	-18
620	-8	-2	0	-17	-11	-5	-34	-28	-22
580	-9	-3	0	-20	-14	-8	-38	-32	-26
540	-10	-4	0	-23	-17	-11	-42	-36	-30
500	-12	-6	0	-26	-20	-14	-47	-41	-35
460	-14	-8	-2	-29	-23	-17	-52	-46	-40
420	-15	-9	-3	-32	-26	-20	-56	-50	-44
380	-17	-11	-5	-35	-29	-23	-61	-55	-49
340	-18	-12	-6	-38	-32	-26	-65	-59	-53

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

Minimum Control Speeds

V1(MCG), Minimum VR

Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)					
		0		4000		8000	
°C	°F	V1(MCG)	Min VR	V1(MCG)	Min VR	V1(MCG)	Min VR
60	140	97	103	95	100		
50	122	100	105	95	100	91	97
40	104	106	111	98	103	91	97
30	86	110	115	102	107	94	99
20	68	110	115	103	108	95	100
-60	-76	111	115	104	109	97	102

T01 V1(MCG), Minimum VR

10% Thrust Reduction

TEMP		PRESSURE ALTITUDE (FT)					
		0		4000		8000	
°C	°F	V1(MCG)	Min VR	V1(MCG)	Min VR	V1(MCG)	Min VR
60	140	93	98	90	95		
50	122	95	101	90	95	87	92
40	104	100	105	93	98	87	92
30	86	104	109	97	102	89	95
20	68	105	109	98	103	90	96
-60	-76	106	110	99	104	92	97

T02 V1(MCG), Minimum VR

20% Thrust Reduction

TEMP		PRESSURE ALTITUDE (FT)					
		0		4000		8000	
°C	°F	V1(MCG)	MinVR	V1(MCG)	MinVR	V1(MCG)	MinVR
60	140	89	94	86	91		
50	122	91	96	86	91	82	88
40	104	95	100	88	94	82	88
30	86	99	104	91	97	85	90
20	68	99	104	93	98	86	91
-60	-76	100	104	94	99	88	93

Go-around EPR
Based on engine bleed for packs on and anti-ice off

REPORTED OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)										
°C	°F	°C	-2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000
56	133	60	1.276	1.274	1.275	1.276	1.278	1.279	1.281	1.293	1.284	1.286	1.289
51	124	55	1.309	1.306	1.306	1.303	1.305	1.308	1.310	1.313	1.315	1.318	1.322
46	115	50	1.346	1.345	1.344	1.341	1.341	1.339	1.340	1.343	1.345	1.350	1.355
41	106	45	1.387	1.387	1.387	1.385	1.383	1.382	1.381	1.380	1.377	1.382	1.388
36	97	40	1.401	1.433	1.430	1.430	1.429	1.426	1.430	1.427	1.427	1.426	1.421
31	88	35	1.401	1.472	1.471	1.470	1.468	1.470	1.469	1.467	1.468	1.459	1.454
26	79	30	1.401	1.481	1.494	1.500	1.495	1.496	1.493	1.492	1.490	1.481	1.472
21	70	25	1.401	1.481	1.494	1.507	1.514	1.512	1.510	1.508	1.506	1.499	1.492
16	61	20	1.401	1.481	1.494	1.507	1.517	1.527	1.526	1.524	1.522	1.515	1.507
11	52	15	1.401	1.481	1.494	1.507	1.517	1.527	1.533	1.539	1.538	1.531	1.524
7	45	10	1.401	1.481	1.494	1.507	1.517	1.527	1.533	1.539	1.545	1.546	1.541
2 & BELOW	36 & BELOW	5 & BELOW	1.401	1.481	1.494	1.507	1.517	1.527	1.533	1.539	1.545	1.546	1.546

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)						
	-1000	0	2000	4000	6000	8000	10000
PACKS OFF	0.013	0.013	0.014	0.016	0.017	0.018	0.020
2 PACK ON - 2 BLEED SOURCES	0	0	0	0	0	0	0
2 PACK ON - 1 BLEED SOURCES	-0.013	-0.014	-0.015	-0.016	-0.016	-0.018	-0.020
1 PACK ON - 2 BLEED SOURCE	-0.013	-0.014	-0.015	-0.016	-0.016	-0.018	-0.020
1 PACK ON - 1 BLEED SOURCE	-0.013	-0.014	-0.015	-0.016	-0.016	-0.018	-0.020
WING ANTI-ICE ON	0.006	0.006	0.008	0.008	0.008	0.009	0.010

Max Climb EPR

Based on engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)/SPEED (IAS OR MACH)									
	0	5	10	15	20	25	30	35	40	43
	310	310	310	310	310	310	310	0.84	0.84	0.84
60	1.148	1.134	1.141	1.151	1.154	1.104	1.100	1.171	1.186	1.201
50	1.186	1.171	1.158	1.151	1.154	1.104	1.100	1.171	1.186	1.201
40	1.210	1.212	1.198	1.186	1.161	1.104	1.100	1.171	1.186	1.201
30	1.210	1.234	1.252	1.241	1.209	1.153	1.113	1.171	1.186	1.201
20	1.210	1.234	1.264	1.301	1.277	1.248	1.223	1.193	1.186	1.201
10	1.210	1.234	1.264	1.301	1.330	1.382	1.338	1.294	1.281	1.289
0	1.210	1.234	1.264	1.301	1.330	1.410	1.441	1.401	1.384	1.384
-10	1.210	1.234	1.264	1.301	1.330	1.410	1.458	1.487	1.474	1.472
-15 & BELOW	1.210	1.234	1.264	1.301	1.330	1.410	1.458	1.503	1.505	1.504

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	0	10	20	30	40	43
ENGINE ONLY	-0.016	-0.015	-0.017	-0.019	-0.019	-0.021
ENGINE & WING*	-0.022	-0.025	-0.030	-0.034	-0.038	-0.042
ENGINE & WING**	-0.029	-0.035	-0.043	-0.048	-0.056	-0.063

*Wing anti-ice on, packs on.

**Wing anti-ice on, single bleed source and both packs off.

Flight With Unreliable Airspeed / Turbulent Air Penetration
Altitude and/or vertical speed indications may also be unreliable.

Climb

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 LB)			
		400	500	600	700
40000 (.82M)	PITCH ATT V/S (FT/MIN)	3.5 800			
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	4.0 1800	4.0 1200	4.0 700	
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	6.5 2900	6.0 2100	6.0 1500	6.5 1000
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	9.0 3900	8.0 2900	8.0 2200	8.0 1700
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	11.5 4700	10.5 3600	9.5 2800	9.5 2300

Cruise

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 LB)			
		400	500	600	700
40000 (.82M)	PITCH ATT EPR (Alt Mode %N1)	2.5 1.211 (83.6)			
35000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 1.092 (79.8)	2.0 1.18 (83.1)	3.0 1.370 (89.7)	
30000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	2.0 1.027 (76.3)	2.5 1.082 (79.0)	3.0 1.168 (82.8)	4.0 1.336 (89.2)
25000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	2.0 0.988 (72.5)	2.5 1.024 (75.2)	3.5 1.084 (78.6)	4.0 1.162 (82.4)
20000 (270 KIAS)	PITCH ATT EPR (Alt Mode %N1)	2.0 0.973 (68.0)	3.0 1.001 (70.6)	4.0 1.042 (74.5)	5.0 1.101 (78.5)
15000 (270 KIAS)	PITCH ATT EPR (Alt Mode %N1)	2.0 0.969 (64.9)	3.0 0.988 (67.3)	4.0 1.018 (70.2)	5.0 1.057 (74.1)

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Descent

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 LB)			
		400	500	600	700
40000 (.82M)	PITCH ATT V/S (FT/MIN)	-0.5 -2500			
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	-1.0 -2100	0.0 -1900	1.0 -1900	
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	-0.5 -1700	0.5 -1600	1.5 -1600	2.0 -1600
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	-1.0 -1600	0.0 -1500	1.0 -1400	2.0 -1400
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	-1.5 -1600	-0.5 -1400	1.0 -1400	2.0 -1400

Holding

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB)			
		400	500	600	700
10000	PITCH ATT	4.5	5.0	5.0	4.5
	EPR	1.002	1.012	1.019	1.028
	(Alt Mode %N1)	(55.8)	(61.5)	(66.3)	(70.0)
	KIAS	210	227	249	271
5000	PITCH ATT	4.0	4.5	5.0	5.0
	EPR	0.998	1.006	1.010	1.016
	(Alt Mode %N1)	(51.5)	(57.2)	(62.2)	(66.3)
	KIAS	210	226	248	268

Terminal Area (5000 FT)

Set Thrust for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 LB)			
		400	500	600	700
FLAPS 0 (GEAR UP) (VREF30 + 80)	PITCH ATT	4.5	5.0	5.5	5.5
	EPR	1.000	1.010	1.020	1.030
	(Alt Mode %N1)	(52.3)	(58.1)	(63.5)	(67.9)
	KIAS	210	226	240	255
FLAPS 1 (GEAR UP) (VREF30 + 60)	PITCH ATT	6.0	6.5	7.0	7.0
	EPR	1.010	1.020	1.040	1.060
	(Alt Mode %N1)	(52.7)	(59.0)	(64.6)	(69.5)
	KIAS	190	206	220	235
FLAPS 5 (GEAR UP) (VREF30 + 40)	PITCH ATT	5.0	5.5	6.0	6.0
	EPR	1.030	1.040	1.060	1.080
	(Alt Mode %N1)	(54.0)	(60.7)	(66.1)	(70.8)
	KIAS	170	186	200	215
FLAPS 15 (GEAR UP) (VREF30 + 20)	PITCH ATT	5.5	6.0	6.5	6.5
	EPR	1.040	1.060	1.090	1.110
	(Alt Mode %N1)	(55.6)	(62.5)	(68.1)	(72.5)
	KIAS	150	166	180	195
FLAPS 20 (GEAR DOWN) (VREF30 + 20)	PITCH ATT	4.5	5.0	5.5	5.0
	EPR	1.070	1.100	1.140	1.170
	(Alt Mode %N1)	(62.4)	(69.2)	(74.4)	(79.0)
	KIAS	150	166	180	195

Flight With Unreliable Airspeed / Turbulent Air Penetration
Altitude and/or vertical speed indications may also be unreliable.
Final Approach (1500 FT)
Gear Down, Set Thrust for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 LB)			
		400	500	600	700
FLAPS 20 (VREF20 + 10)	PITCH ATT	1.0	1.5	1.5	1.5
	EPR	1.000	1.010	1.010	1.020
	(Alt Mode %N1)	(41.3)	(45.7)	(49.9)	(53.5)
	KIAS	153	170	185	198
FLAPS 25 (VREF25 + 10)	PITCH ATT	1.0	1.0	1.0	1.5
	EPR	1.030	1.040	1.060	1.070
	(Alt Mode %N1)	(50.6)	(56.1)	(60.9)	(65.0)
	KIAS	146	162	176	189
FLAPS 30 (VREF30 + 10)	PITCH ATT	0.5	0.5	0.5	0.5
	EPR	1.050	1.070	1.090	1.110
	(Alt Mode %N1)	(55.6)	(61.1)	(65.9)	(70.7)
	KIAS	140	156	170	184

Performance Inflight

All Engine

Chapter PI

Section 51

Long Range Cruise Maximum Operating Altitude

Max Climb Thrust

ISA + 10°C and Below

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
660	29500	0	32800*	32800*	32800*	32800*	32200
640	30100	-1	33600*	33600*	33600*	33600*	32900
620	30800	-3	34300*	34300*	34300*	34300*	33500
600	31500	-4	35100*	35100*	35100*	35100*	34200
580	32300	-6	35800*	35800*	35800*	35800*	35000
560	33000	-8	36300*	36300*	36300*	36300*	35700
540	33800	-9	37000*	37000*	37000*	37000*	36400
520	34600	-11	37800*	37800*	37800*	37800*	37200
500	35400	-13	38600*	38600*	38600*	38600*	38000
480	36300	-14	39400*	39400*	39400*	39400*	38900
460	37200	-14	40200*	40200*	40200*	40200*	39800
440	38100	-14	41100*	41100*	41100*	41100*	40700
420	39100	-14	42000*	42000*	42000*	42000*	41700
400	40100	-14	43000*	43000*	43000*	43000*	42700
380	41100	-14	43100	43100	43100	43100	43100
360	42300	-14	43100	43100	43100	43100	43100
340	43100	-14	43100	43100	43100	43100	43100

ISA + 15°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
660	29500	6	31800*	31800*	31800*	31800*	31800*
640	30100	5	32600*	32600*	32600*	32600*	32600*
620	30800	3	33400*	33400*	33400*	33400*	33400*
600	31500	1	34300*	34300*	34300*	34300*	34200
580	32300	0	35100*	35100*	35100*	35100*	35000
560	33000	-2	35800*	35800*	35800*	35800*	35700
540	33800	-4	36400*	36400*	36400*	36400*	36400
520	34600	-5	37200*	37200*	37200*	37200*	37200
500	35400	-7	38000*	38000*	38000*	38000*	38000
480	36300	-9	38800*	38800*	38800*	38800*	38800*
460	37200	-9	39600*	39600*	39600*	39600*	39600*
440	38100	-9	40500*	40500*	40500*	40500*	40500*
420	39100	-9	41400*	41400*	41400*	41400*	41400*
400	40100	-9	42300*	42300*	42300*	42300*	42300*
380	41100	-9	43100	43100	43100	43100	43100
360	42300	-9	43100	43100	43100	43100	43100
340	43100	-9	43100	43100	43100	43100	43100

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
660	29500	12	30300*	30300*	30300*	30300*	30300*
640	30100	10	31200*	31200*	31200*	31200*	31200*
620	30800	9	32100*	32100*	32100*	32100*	32100*
600	31500	7	33000*	33000*	33000*	33000*	33000*
580	32300	6	34000*	34000*	34000*	34000*	34000*
560	33000	4	34900*	34900*	34900*	34900*	34900*
540	33800	2	35600*	35600*	35600*	35600*	35600*
520	34600	0	36200*	36200*	36200*	36200*	36200*
500	35400	-2	37000*	37000*	37000*	37000*	37000*
480	36300	-3	37800*	37800*	37800*	37800*	37800*
460	37200	-3	38700*	38700*	38700*	38700*	38700*
440	38100	-3	39500*	39500*	39500*	39500*	39500*
420	39100	-3	40400*	40400*	40400*	40400*	40400*
400	40100	-3	41300*	41300*	41300*	41300*	41300*
380	41100	-3	42300*	42300*	42300*	42300*	42300*
360	42300	-3	43100	43100	43100	43100	43100
340	43100	-3	43100	43100	43100	43100	43100

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)									
		25	27	29	31	33	35	37	39	41	43
660	EPR	1.090	1.125	1.172	1.250	1.370					
	MACH	.772	.802	.834	.841	.839					
	KIAS	325	325	325	314	300					
	FF/ENG	9724	9828	10065	10189	10650					
620	EPR	1.069	1.100	1.140	1.199	1.286					
	MACH	.772	.802	.834	.841	.841					
	KIAS	325	325	325	314	301					
	FF/ENG	9343	9405	9586	9535	9619					
580	EPR	1.052	1.079	1.111	1.157	1.224	1.325				
	MACH	.772	.802	.828	.838	.841	.840				
	KIAS	325	325	322	313	301	287				
	FF/ENG	9022	9054	9067	8966	8903	9099				
540	EPR	1.036	1.061	1.088	1.123	1.174	1.249	1.367			
	MACH	.754	.785	.813	.831	.839	.841	.839			
	KIAS	317	317	316	310	300	288	274			
	FF/ENG	8469	8495	8493	8410	8316	8291	8668			
500	EPR	1.021	1.041	1.067	1.095	1.134	1.189	1.273	1.408		
	MACH	.726	.758	.789	.816	.833	.840	.841	.838		
	KIAS	304	305	306	304	297	287	275	261		
	FF/ENG	7809	7842	7861	7848	7760	7673	7734	8277		
460	EPR	1.006	1.024	1.045	1.072	1.101	1.143	1.204	1.294		
	MACH	.699	.728	.760	.792	.818	.834	.840	.841		
	KIAS	292	292	294	294	292	285	274	262		
	FF/ENG	7189	7184	7218	7225	7205	7121	7087	7227		
420	EPR	.994	1.007	1.026	1.047	1.074	1.105	1.150	1.216	1.307	
	MACH	.672	.698	.727	.760	.792	.819	.835	.840	.841	
	KIAS	280	280	280	281	282	279	272	262	250	
	FF/ENG	6616	6566	6564	6590	6589	6571	6533	6548	6696	
380	EPR	.985	.994	1.007	1.026	1.047	1.073	1.108	1.155	1.219	1.310
	MACH	.645	.669	.695	.724	.757	.791	.818	.834	.840	.841
	KIAS	268	267	266	267	268	268	266	260	250	239
	FF/ENG	6060	5995	5947	5941	5960	5969	5979	5987	6000	6133
340	EPR	.977	.984	.993	1.006	1.023	1.044	1.072	1.108	1.153	1.216
	MACH	.615	.639	.663	.689	.718	.751	.785	.815	.832	.840
	KIAS	255	254	253	253	253	254	254	253	247	239
	FF/ENG	5608	5553	5380	5332	5314	5332	5371	5422	5433	5443

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitude
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
283	262	243	226	213	200	191	182	174	167	161
423	392	364	340	319	300	286	274	262	252	243
564	522	485	453	425	400	382	366	351	337	325
705	653	606	566	531	500	478	457	439	422	407
846	783	727	680	638	600	574	549	527	507	489
987	914	849	793	744	700	670	642	616	592	570
1128	1044	970	906	850	800	766	734	704	677	652
1271	1176	1092	1020	957	900	861	825	792	762	734
1413	1308	1214	1133	1063	1000	957	917	880	846	816
1555	1439	1335	1247	1170	1100	1053	1009	968	931	898
1698	1571	1458	1361	1276	1200	1148	1101	1056	1016	979
1841	1703	1580	1475	1383	1300	1244	1192	1145	1101	1061
1984	1835	1702	1589	1489	1400	1340	1284	1233	1185	1142
2128	1968	1825	1703	1596	1500	1436	1376	1321	1270	1224
2272	2100	1948	1817	1703	1600	1532	1468	1409	1355	1305
2417	2234	2070	1931	1809	1700	1627	1559	1497	1439	1387
2562	2367	2193	2045	1916	1800	1723	1651	1584	1524	1468
2707	2500	2316	2159	2023	1900	1818	1742	1672	1608	1549
2852	2634	2439	2274	2129	2000	1914	1834	1760	1692	1630

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	8.9	0:39	7.6	0:37	6.2	0:35	5.4	0:34	4.8	0:33
300	13.6	0:56	12.0	0:53	10.0	0:50	9.0	0:48	8.2	0:46
400	18.4	1:13	16.3	1:10	13.9	1:05	12.7	1:02	11.6	1:00
500	23.1	1:30	20.7	1:26	17.7	1:20	16.2	1:17	15.0	1:13
600	27.8	1:48	25.1	1:42	21.6	1:35	19.8	1:31	18.3	1:26
700	32.5	2:05	29.5	1:59	25.4	1:50	23.4	1:45	21.7	1:39
800	37.2	2:23	33.9	2:15	29.2	2:05	26.9	1:59	25.0	1:53
900	41.9	2:41	38.2	2:32	33.0	2:20	30.4	2:13	28.3	2:06
1000	46.6	2:58	42.5	2:48	36.7	2:36	34.0	2:28	31.7	2:19
1100	51.2	3:16	46.8	3:05	40.6	2:51	37.5	2:42	34.9	2:33
1200	55.9	3:34	51.1	3:22	44.4	3:06	41.0	2:57	38.2	2:46
1300	60.5	3:52	55.4	3:39	48.2	3:21	44.4	3:11	41.5	3:00
1400	65.1	4:11	59.7	3:56	52.0	3:37	47.9	3:26	44.8	3:13
1500	69.7	4:29	63.9	4:13	55.7	3:52	51.4	3:40	48.0	3:27
1600	74.3	4:47	68.1	4:30	59.5	4:08	54.8	3:55	51.2	3:41
1700	78.8	5:06	72.3	4:47	63.2	4:23	58.2	4:10	54.5	3:55
1800	83.3	5:24	76.5	5:04	66.9	4:39	61.7	4:24	57.7	4:08
1900	87.8	5:43	80.7	5:22	70.6	4:55	65.1	4:39	60.9	4:22
2000	92.3	6:02	84.9	5:39	74.3	5:10	68.5	4:54	64.0	4:36

Long Range Cruise Enroute Fuel and Time - Low Altitude
Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)							
	300	350	400	450	500	550	600	650
10	-1.3	-1.1	-0.6	-0.3	0.0	0.4	0.8	1.3
20	-3.4	-2.4	-1.5	-0.8	0.0	1.0	2.0	3.1
30	-5.5	-3.8	-2.4	-1.2	0.0	1.5	3.2	4.9
40	-7.6	-5.3	-3.3	-1.6	0.0	2.1	4.3	6.7
50	-9.6	-6.8	-4.2	-2.1	0.0	2.7	5.5	8.5
60	-11.8	-8.3	-5.2	-2.6	0.0	3.3	6.7	10.2
70	-13.9	-9.9	-6.2	-3.0	0.0	3.9	7.8	11.9
80	-16.1	-11.5	-7.3	-3.5	0.0	4.4	9.0	13.6
90	-18.3	-13.1	-8.4	-4.0	0.0	5.0	10.2	15.3
100	-20.4	-14.8	-9.5	-4.5	0.0	5.6	11.3	17.0

Long Range Cruise Enroute Fuel and Time - High Altitude
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
521	492	465	441	419	400	383	367	352	339	327
1032	976	925	879	838	800	767	736	708	682	658
1545	1462	1386	1318	1257	1200	1151	1106	1064	1025	990
2059	1949	1848	1758	1676	1600	1535	1475	1419	1368	1321
2576	2438	2311	2198	2095	2000	1920	1844	1775	1711	1652
3095	2928	2775	2638	2514	2400	2304	2214	2131	2054	1983
3616	3419	3239	3079	2934	2800	2688	2583	2486	2397	2315
4139	3912	3705	3520	3353	3200	3072	2953	2842	2739	2645
4664	4407	4172	3963	3774	3600	3456	3322	3197	3082	2976
5192	4904	4640	4406	4194	4000	3840	3691	3552	3424	3306
5721	5401	5109	4849	4615	4400	4224	4059	3906	3765	3636
6253	5901	5579	5294	5036	4800	4607	4428	4261	4107	3965
6787	6402	6051	5739	5458	5200	4991	4796	4615	4448	4295
7324	6905	6523	6185	5880	5600	5375	5164	4969	4789	4623
7863	7410	6997	6631	6302	6000	5758	5532	5322	5128	4951
8405	7917	7472	7078	6724	6400	6141	5899	5674	5467	5277
8950	8426	7949	7526	7147	6800	6523	6266	6026	5805	5603
9497	8936	8426	7975	7571	7200	6906	6632	6378	6143	5929
10048	9449	8905	8425	7994	7600	7289	6998	6729	6480	6253
10601	9964	9385	8875	8418	8000	7671	7364	7079	6817	6577

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37 & ABOVE	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
400	11.9	0:57	11.5	0:56	11.1	0:56	11.0	0:57	11.1	0:58
800	24.7	1:51	23.9	1:48	23.2	1:47	22.8	1:47	22.8	1:47
1200	37.5	2:44	36.3	2:40	35.3	2:37	34.7	2:37	34.6	2:37
1600	50.3	3:38	48.7	3:32	47.4	3:28	46.5	3:27	46.3	3:27
2000	63.0	4:32	61.1	4:24	59.5	4:18	58.4	4:17	58.1	4:17
2400	75.3	5:27	73.0	5:17	71.1	5:10	69.7	5:07	69.2	5:07
2800	87.6	6:23	85.0	6:11	82.7	6:02	81.0	5:58	80.4	5:56
3200	99.6	7:19	96.7	7:05	94.1	6:54	92.1	6:49	91.2	6:47
3600	111.4	8:17	108.2	8:00	105.2	7:48	102.9	7:40	101.9	7:37
4000	123.2	9:14	119.7	8:56	116.3	8:41	113.8	8:32	112.5	8:28
4400	134.6	10:14	130.7	9:53	127.1	9:36	124.2	9:25	122.6	9:19
4800	146.0	11:13	141.7	10:50	137.8	10:31	134.6	10:18	132.8	10:10
5200	157.2	12:13	152.5	11:49	148.3	11:27	144.9	11:12	142.8	11:02
5600	168.3	13:15	163.1	12:48	158.6	12:24	154.9	12:06	152.5	11:55
6000	179.3	14:16	173.7	13:47	168.9	13:21	164.9	13:01	162.3	12:47
6400	190.1	15:20	184.1	14:49	178.8	14:20	174.5	13:58	171.6	13:41
6800	200.8	16:24	194.4	15:50	188.7	15:19	184.2	14:55	181.0	14:35
7200	211.4	17:29	204.6	16:52	198.5	16:19	193.6	15:52	190.2	15:31
7600	221.7	18:35	214.7	17:56	208.2	17:20	202.9	16:51	199.2	16:27
8000	232.0	19:41	224.7	18:59	218.0	18:21	212.1	17:50	208.2	17:23

Long Range Cruise Enroute Fuel and Time - High Altitude Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)							
	300	350	400	450	500	550	600	650
10	-1.9	-1.9	-1.4	-0.7	0.0	1.9	5.8	11.7
20	-3.8	-3.3	-2.5	-1.2	0.0	2.9	8.2	15.9
30	-5.8	-4.8	-3.5	-1.7	0.0	3.8	10.5	20.0
40	-7.8	-6.2	-4.4	-2.2	0.0	4.7	12.7	23.8
50	-9.9	-7.7	-5.4	-2.7	0.0	5.6	14.8	27.5
60	-11.9	-9.2	-6.3	-3.2	0.0	6.5	16.9	31.1
70	-14.1	-10.8	-7.3	-3.8	0.0	7.3	18.8	34.4
80	-16.2	-12.3	-8.3	-4.3	0.0	8.2	20.7	37.6
90	-18.4	-13.9	-9.3	-4.8	0.0	9.0	22.5	40.6
100	-20.6	-15.5	-10.3	-5.3	0.0	9.7	24.2	43.5
110	-22.9	-17.1	-11.4	-5.9	0.0	10.5	25.9	46.1
120	-25.2	-18.7	-12.4	-6.4	0.0	11.2	27.4	48.6
130	-27.5	-20.4	-13.5	-6.9	0.0	11.9	28.9	50.9
140	-29.8	-22.1	-14.5	-7.5	0.0	12.6	30.3	53.1
150	-32.2	-23.8	-15.6	-8.0	0.0	13.2	31.6	55.0
160	-34.6	-25.5	-16.7	-8.6	0.0	13.9	32.8	56.8
170	-37.1	-27.3	-17.8	-9.1	0.0	14.5	33.9	58.4
180	-39.6	-29.1	-19.0	-9.7	0.0	15.1	35.0	59.8
190	-42.1	-30.9	-20.1	-10.2	0.0	15.6	36.0	61.1
200	-44.7	-32.7	-21.3	-10.8	0.0	16.2	36.9	62.2
210	-47.3	-34.5	-22.4	-11.3	0.0	16.7	37.7	63.1
220	-49.9	-36.4	-23.6	-11.9	0.0	17.2	38.4	63.8
230	-52.6	-38.3	-24.8	-12.4	0.0	17.6	39.1	64.3
240	-55.2	-40.2	-26.0	-13.0	0.0	18.1	39.6	64.7

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 LB)								
	660	620	580	540	500	460	420	380	340
43							44	10	0
41						42	11	0	3
39				80	36	10	0	2	14
37			64	28	8	0	2	12	29
35		47	20	5	0	2	12	26	44
33	33	13	2	0	3	12	25	42	59
31	7	0	0	5	13	26	40	56	73
29	0	1	7	15	27	40	55	70	85
27	3	9	18	29	41	55	69	82	96
25	12	21	32	43	56	68	81	93	104

The above wind factor table is for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. Read wind factors for present and new altitudes from table.
2. Determine difference (new altitude wind factor minus present altitude wind factor);
This difference may be negative or positive.
3. Break-even wind at new altitude is present altitude wind plus difference from step 2.

Descent at .84/310/250

PRESSURE ALT (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	97	104	111	119	125	130	135	141	147	152
TIME (MINUTES)	19	20	21	22	23	23	24	25	26	26

**Holding
Flaps Up**

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
660	EPR	1.009	1.013	1.025	1.033	1.041	1.100	1.204			
	KIAS	259	260	261	277	302	306	310			
	FF/ENG	9660	9510	9380	9290	9550	9750	10250			
620	EPR	1.007	1.011	1.021	1.033	1.034	1.082	1.169			
	KIAS	251	252	253	262	287	296	300			
	FF/ENG	9060	8960	8820	8660	8830	9080	9430			
580	EPR	1.006	1.010	1.017	1.032	1.034	1.066	1.139	1.321		
	KIAS	243	244	245	248	269	285	289	279		
	FF/ENG	8610	8540	8390	8190	8100	8430	8670	9270		
540	EPR	1.005	1.008	1.014	1.027	1.034	1.049	1.113	1.241		
	KIAS	234	235	236	237	252	275	278	279		
	FF/ENG	8050	7950	7850	7630	7560	7790	7960	8400		
500	EPR	1.003	1.006	1.012	1.022	1.034	1.039	1.090	1.188		
	KIAS	226	226	227	228	235	259	267	271		
	FF/ENG	7500	7370	7300	7090	6930	7090	7290	7600		
460	EPR	1.000	1.003	1.008	1.016	1.032	1.039	1.068	1.147	1.350	
	KIAS	220	220	220	220	220	238	255	259	249	
	FF/ENG	6970	6830	6750	6560	6380	6400	6660	6850	7580	
420	EPR	.996	.999	1.004	1.010	1.021	1.037	1.047	1.112	1.248	
	KIAS	213	213	213	213	213	220	243	246	249	
	FF/ENG	6430	6310	6180	6040	5900	5880	6020	6150	6670	
380	EPR	.993	.996	1.000	1.005	1.012	1.031	1.041	1.081	1.182	1.302
	KIAS	206	206	206	206	206	206	221	233	237	232
	FF/ENG	5900	5790	5660	5530	5420	5310	5420	5510	5850	6220
340	EPR	.991	.993	.996	1.000	1.005	1.019	1.039	1.054	1.130	1.211
	KIAS	199	199	199	199	199	199	199	219	223	225
	FF/ENG	5400	5280	5160	5020	4960	4800	4770	4930	5110	5380

This table includes 5% additional fuel for holding in a racetrack pattern.

**Holding
Flaps 1**

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
660	EPR	1.038	1.050	1.071	1.108	1.164
	KIAS	229	229	229	229	229
	FF/ENG	10050	9940	9850	9600	9690
620	EPR	1.034	1.044	1.063	1.094	1.143
	KIAS	222	222	222	222	222
	FF/ENG	9420	9320	9250	9000	8990
580	EPR	1.028	1.037	1.054	1.079	1.121
	KIAS	217	217	217	217	217
	FF/ENG	8950	8840	8740	8520	8290
540	EPR	1.023	1.030	1.045	1.065	1.099
	KIAS	212	212	212	212	212
	FF/ENG	8360	8230	8140	7930	7790
500	EPR	1.019	1.025	1.037	1.054	1.079
	KIAS	206	206	206	206	206
	FF/ENG	7760	7630	7540	7360	7220
460	EPR	1.014	1.020	1.030	1.044	1.062
	KIAS	200	200	200	200	200
	FF/ENG	7160	7050	6940	6790	6660
420	EPR	1.009	1.015	1.024	1.035	1.047
	KIAS	193	193	193	193	193
	FF/ENG	6570	6470	6360	6230	6120
380	EPR	1.005	1.010	1.018	1.027	1.035
	KIAS	186	186	186	186	186
	FF/ENG	5990	5890	5790	5670	5590
340	EPR	1.001	1.005	1.012	1.020	1.025
	KIAS	179	179	179	179	179
	FF/ENG	5420	5320	5240	5140	5080

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight Advisory Information

Chapter PI Section 52

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 30

Dry Runway

	LANDING DISTANCE AND ADJUSTMENTS (FT)											
	REF DIST*	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°C		APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	450000 LB LANDING WT	PER 10000 LB ABOVE / BELOW 450000 LB	PER 1000 FT ABOVE S.L.	HEAD WIND	TAIL WIND	DN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF30	ONE REV	NO REV
MAX MANUAL	2950	+70/-40	60	-120	430	40	-30	60	-60	230	50	120
MAX AUTO	3980	+60/-40	90	-170	610	0	0	90	-100	410	0	0
AUTOBRAKE 4	4940	+80/-60	130	-240	850	0	-20	130	-130	520	0	0
AUTOBRAKE 3	5970	+100/-80	160	-290	1060	40	-70	160	-160	560	10	20
AUTOBRAKE 2	6640	+120/-110	190	-340	1220	100	-140	180	-180	530	190	190
AUTOBRAKE 1	7010	+140/-120	220	-370	1360	160	-190	200	-190	530	480	580

Good Reported Braking Action

MAX MANUAL	4040	+70/-70	100	-200	750	100	-90	100	-100	320	220	500
MAX AUTO	4450	+70/-70	110	-210	770	80	-50	100	-100	410	220	520
AUTOBRAKE 4	4960	+80/-80	130	-240	880	20	-30	130	-130	520	20	80
AUTOBRAKE 3	5970	+100/-110	160	-290	1060	40	-70	160	-160	560	10	20

Medium Reported Braking Action

MAX MANUAL	5420	+100/-100	160	-310	1240	260	-190	140	-140	410	580	1460
MAX AUTO	5720	+100/-100	160	-310	1230	240	-160	140	-140	480	550	1410
AUTOBRAKE 4	5720	+100/-100	160	-310	1250	220	-140	150	-150	510	540	1460
AUTOBRAKE 3	6250	+110/-110	170	-340	1330	180	-140	170	-170	560	280	980

Poor Reported Braking Action

MAX MANUAL	6930	+150/-140	230	-460	1960	630	-370	190	-180	470	1230	3390
MAX AUTO	7320	+150/-140	230	-450	1940	640	-360	190	-180	490	1240	3430
AUTOBRAKE 4	7320	+150/-140	230	-460	1950	620	-380	190	-180	460	1260	3470
AUTOBRAKE 3	7340	+150/-140	230	-470	1970	590	-330	200	-190	560	1100	3330

*Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and 2 engine reverse thrust.

Max Manual braking data valid for auto speedbrakes. For manual speedbrakes, increase reference landing distance by 200 ft.

Autobrake data valid for both auto and manual speedbrakes.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION**Normal Configuration Landing Distance****Flaps 25****Dry Runway**

	LANDING DISTANCE AND ADJUSTMENTS (FT)											
	REF DIST*	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°C		APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	450000 LB LANDING WT	PER 10000 LB ABOVE BELOW 450000 LB	PER 1000 FT ABOVE S.L.	HEAD WIND	TAIL WIND	DN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF25	ONE REV	NO REV
MAX MANUAL	3050	+80/-40	70	-120	440	40	-30	60	-60	230	60	140
MAX AUTO	4210	+60/-40	100	-180	630	0	0	100	-100	420	0	0
AUTOBRAKE 4	5260	+90/-70	140	-250	880	0	-30	140	-140	530	0	0
AUTOBRAKE 3	6370	+110/-90	180	-310	1090	50	-90	170	-170	550	40	50
AUTOBRAKE 2	7020	+130/-120	210	-350	1250	120	-160	190	-190	520	300	300
AUTOBRAKE 1	7360	+150/-140	240	-380	1390	190	-210	210	-200	530	620	780

Good Reported Braking Action

MAX MANUAL	4200	+70/-70	110	-200	760	100	-90	100	-100	320	250	580
MAX AUTO	4660	+70/-70	120	-210	790	70	-50	110	-110	420	230	580
AUTOBRAKE 4	5270	+90/-90	140	-250	910	20	-30	140	-140	530	20	80
AUTOBRAKE 3	6370	+110/-120	180	-310	1090	50	-90	170	-170	550	40	50

Medium Reported Braking Action

MAX MANUAL	5630	+110/-110	170	-320	1250	260	-200	150	-150	410	660	1680
MAX AUTO	5960	+110/-110	170	-310	1250	240	-160	150	-150	480	630	1630
AUTOBRAKE 4	5960	+110/-110	170	-320	1270	210	-140	160	-160	530	540	1620
AUTOBRAKE 3	6650	+120/-120	190	-350	1360	180	-160	180	-180	550	300	1080

Poor Reported Braking Action

MAX MANUAL	7180	+150/-150	240	-470	1980	640	-380	200	-190	470	1370	3900
MAX AUTO	7620	+150/-140	240	-460	1970	640	-370	200	-190	490	1380	3930
AUTOBRAKE 4	7620	+150/-140	240	-460	1970	620	-370	200	-190	480	1400	3990
AUTOBRAKE 3	7690	+150/-150	240	-470	2010	590	-350	210	-200	550	1180	3770

*Reference distance is for sea level, standard day, no wind or slope, VREF25 approach speed and 2 engine reverse thrust.

Max Manual braking data valid for auto speedbrakes. For manual speedbrakes, increase reference landing distance by 200 ft.

Autobrake data valid for both auto and manual speedbrakes.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 20

Dry Runway

	LANDING DISTANCE AND ADJUSTMENTS (FT)											
	REF DIST*	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°C		APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	450000 LB LANDING WT	PER 10000 LB ABOVE / BELOW 450000 LB	PER 1000 FT ABOVE S.L.	HEAD WIND	TAIL WIND	DN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF20	ONE REV	NO REV
MAX MANUAL	3240	+90/-50	70	-130	440	40	-40	70	-70	240	70	170
MAX AUTO	4520	+70/-70	110	-190	630	0	0	110	-110	440	0	0
AUTOBRAKE 4	5680	+100/-100	150	-260	880	0	-30	160	-160	570	0	0
AUTOBRAKE 3	6760	+120/-130	200	-320	1100	60	-100	190	-190	590	50	60
AUTOBRAKE 2	7360	+140/-150	240	-370	1250	140	-170	220	-210	570	330	340
AUTOBRAKE 1	7790	+160/-170	270	-400	1390	210	-230	230	-230	580	720	850

Good Reported Braking Action

MAX MANUAL	4510	+80/-80	120	-210	750	110	-100	110	-110	340	290	680
MAX AUTO	4790	+80/-80	130	-220	780	70	-50	120	-120	440	270	680
AUTOBRAKE 4	5690	+100/-100	150	-260	910	20	-40	160	-160	570	20	100
AUTOBRAKE 3	6760	+120/-130	200	-320	1100	60	-100	190	-190	590	50	60

Medium Reported Braking Action

MAX MANUAL	6090	+120/-120	190	-330	1220	270	-210	160	-160	430	770	1990
MAX AUTO	6090	+120/-120	190	-330	1210	240	-180	170	-160	500	730	1930
AUTOBRAKE 4	6270	+120/-120	190	-340	1240	200	-150	170	-170	560	630	1920
AUTOBRAKE 3	7040	+130/-130	210	-370	1340	180	-170	200	-200	590	350	1290

Poor Reported Braking Action

MAX MANUAL	7790	+170/-160	270	-490	1900	620	-410	220	-210	500	1600	4630
MAX AUTO	7790	+170/-160	270	-480	1880	610	-400	220	-210	510	1610	4670
AUTOBRAKE 4	7790	+170/-160	270	-490	1890	600	-400	220	-210	520	1630	4740
AUTOBRAKE 3	8010	+170/-160	270	-500	1920	560	-370	230	-220	590	1380	4490

*Reference distance is for sea level, standard day, no wind or slope, VREF20 approach speed and 2 engine reverse thrust.

Max Manual braking data valid for auto speedbrakes. For manual speedbrakes, increase reference landing distance by 190 ft.

Autobrake data valid for both auto and manual speedbrakes.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****Dry Runway**

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
EICAS MESSAGE	VREF	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
		450000 LB LDG WT	PER 10000 LB ABV/BLW 450000 LB	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	5630	110/-110	180	-320/1210	260/-200	80/-80	410	660	1680
ANTISKID (FLAPS 30)	VREF30	5420	100/-100	170	-310/1190	250/-190	80/-80	410	580	1450
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	3300	100/-50	80	-130/480	50/-40	40/-40	270	-	100
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	2980	80/-40	70	-120/450	40/-40	40/-40	250	-	70
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	3970	130/-70	120	-150/600	60/-50	50/-50	290	160	390
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	3400	100/-40	80	-130/490	50/-40	40/-40	260	110	250
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	3240	90/-50	80	-130/470	50/-40	40/-40	250	90	190
FLAPS PRIMARY FAIL	VREF20	3630	90/-50	90	-140/500	50/-40	50/-40	290	100	220
FLAP/SLAT CONTROL	VREF20	3220	90/-50	80	-130/470	50/-40	40/-40	240	90	190
FLIGHT CONTROL MODE	VREF20	3730	90/-50	90	-140/500	50/-50	50/-50	310	110	240
HYD PRESS SYS C	VREF20	3630	90/-50	90	-140/500	50/-40	50/-40	290	100	220
HYD PRESS SYS L+C	VREF30+20	4140	100/-60	100	-160/550	70/-60	50/-50	380	-	160
HYD PRESS SYS L+R	VREF30+20	4840	80/-70	130	-210/720	130/-110	70/-70	480	-	-
HYD PRESS SYS R+C	VREF30+20	5140	70/-80	140	-220/750	130/-110	70/-70	500	-	380
HYD PRESS SYS L (FLAPS 25)	VREF25	3270	90/-50	80	-140/480	50/-50	40/-40	280	-	100
HYD PRESS SYS L (FLAPS 30)	VREF30	3150	80/-40	70	-130/470	50/-40	40/-40	280	-	90
HYD PRESS SYS R (FLAPS 25)	VREF25	3810	60/-60	100	-170/590	80/-70	50/-50	340	-	180
HYD PRESS SYS R (FLAPS 30)	VREF30	3640	60/-60	90	-160/580	70/-60	50/-50	340	-	150
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	3870	120/-60	110	-150/570	60/-50	50/-50	270	140	320
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	3340	100/-40	80	-130/480	50/-40	40/-40	250	90	200
PRI FLIGHT COMPUTERS	VREF20	3730	90/-50	90	-140/500	50/-50	50/-50	310	110	240
SLATS DRIVE	VREF30+30	3690	110/-50	100	-140/510	50/-50	50/-50	260	120	260
STABILIZER	VREF30+20	3440	90/-50	80	-140/480	50/-40	40/-40	260	100	220

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (1000 ft air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Good Reported Braking Action

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	450000 LB LDG WT	PER 10000 LB ABV/BLW 450000 LB	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	5630	110/-110	180	-320/1210	260/-200	80/-80	410	660	1680
ANTISKID (FLAPS 30)	VREF30	5420	100/-100	170	-310/1190	250/-190	80/-80	410	580	1450
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	4740	80/-80	130	-220/810	140/-110	70/-70	380	-	370
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	4210	70/-70	110	-200/760	120/-100	60/-60	350	-	270
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	5290	80/-80	160	-220/820	120/-100	80/-70	330	420	1020
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	4750	80/-80	140	-210/780	120/-100	70/-60	340	360	850
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	4510	80/-80	130	-210/760	120/-100	60/-60	340	290	680
FLAPS PRIMARY FAIL	VREF20	4970	80/-90	140	-220/820	130/-110	70/-70	410	350	820
FLAP/SLAT CONTROL	VREF20	4460	80/-80	120	-210/760	110/-90	60/-60	330	280	650
FLIGHT CONTROL MODE	VREF20	5120	90/-90	150	-230/840	140/-120	70/-70	440	380	920
HYD PRESS SYS C	VREF20	4970	80/-90	140	-220/820	130/-110	70/-70	410	350	820
HYD PRESS SYS L+C	VREF30+20	5980	100/-90	180	-270/960	210/-160	90/-90	540	-	640
HYD PRESS SYS L+R	VREF30+20	6320	90/-100	190	-300/1030	270/-220	100/-100	610	-	-
HYD PRESS SYS R+C	VREF30+20	6140	100/-100	180	-280/970	220/-180	90/-90	590	-	700
HYD PRESS SYS L (FLAPS 25)	VREF25	4710	80/-80	130	-230/830	150/-120	70/-70	410	-	400
HYD PRESS SYS L (FLAPS 30)	VREF30	4530	80/-80	130	-220/820	140/-120	60/-60	420	-	350
HYD PRESS SYS R (FLAPS 25)	VREF25	4710	80/-80	130	-230/830	150/-120	70/-70	410	-	400
HYD PRESS SYS R (FLAPS 30)	VREF30	4480	80/-70	120	-220/810	140/-120	60/-60	410	-	340
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	5220	80/-80	150	-220/810	120/-100	80/-70	310	390	930
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	4590	70/-70	130	-210/770	110/-90	60/-60	310	280	660
PRI FLIGHT COMPUTERS	VREF20	5120	90/-90	150	-230/840	140/-120	70/-70	440	380	920
SLATS DRIVE	VREF30+30	5150	80/-80	150	-220/820	130/-110	70/-70	350	370	860
STABILIZER	VREF30+20	4790	80/-80	140	-220/790	120/-100	70/-70	350	330	760

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (1000 ft air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****Medium Reported Braking Action**

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
EICAS MESSAGE	VREF	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
		450000 LB LDG WT	PER 10000 LB ABV/BLW 450000 LB	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	7180	150/-150	250	-460/1900	610/-380	110/-100	470	1370	3890
ANTISKID (FLAPS 30)	VREF30	6930	150/-140	230	-460/1880	610/-380	110/-100	470	1230	3380
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	6720	130/-130	210	-360/1380	380/-280	110/-100	500	-	1130
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	5870	110/-110	180	-340/1290	330/-240	90/-90	460	-	810
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	7240	130/-130	250	-350/1340	310/-240	110/-110	440	1130	3070
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	6400	120/-120	210	-340/1280	290/-220	100/-90	440	940	2510
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	6090	120/-120	200	-330/1260	290/-210	90/-90	430	770	1980
FLAPS PRIMARY FAIL	VREF20	6610	130/-130	220	-350/1320	320/-240	100/-90	500	900	2370
FLAP/SLAT CONTROL	VREF20	6000	120/-110	190	-320/1240	280/-210	90/-90	420	740	1890
FLIGHT CONTROL MODE	VREF20	6840	140/-130	230	-360/1350	350/-260	100/-100	550	1000	2680
HYD PRESS SYS C	VREF20	6610	130/-130	220	-350/1320	320/-240	100/-90	500	900	2370
HYD PRESS SYS L+C	VREF30+20	8480	150/-150	290	-440/1620	570/-400	140/-130	700	-	1940
HYD PRESS SYS L+R	VREF30+20	9960	160/-160	330	-530/1920	920/-620	170/-170	840	-	-
HYD PRESS SYS R+C	VREF30+20	8660	160/-160	300	-450/1640	580/-420	140/-140	730	-	2070
HYD PRESS SYS L (FLAPS 25)	VREF25	6710	130/-130	220	-380/1430	410/-300	100/-100	540	-	1230
HYD PRESS SYS L (FLAPS 30)	VREF30	6450	120/-120	210	-370/1410	410/-300	100/-100	550	-	1070
HYD PRESS SYS R (FLAPS 25)	VREF25	6660	120/-120	220	-380/1430	410/-300	100/-100	530	-	1200
HYD PRESS SYS R (FLAPS 30)	VREF30	6300	120/-120	200	-370/1390	390/-280	100/-100	520	-	1000
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	7020	130/-120	230	-340/1310	290/-220	110/-100	400	990	2610
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	6190	110/-110	200	-330/1250	280/-210	90/-90	400	750	1900
PRI FLIGHT COMPUTERS	VREF20	6840	140/-130	230	-360/1350	350/-260	100/-100	550	1000	2680
SLATS DRIVE	VREF30+30	6890	130/-120	230	-350/1320	310/-240	110/-100	440	920	2360
STABILIZER	VREF30+20	6430	120/-120	210	-340/1280	300/-220	100/-90	440	840	2150

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (1000 ft air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance Poor Reported Braking Action

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	450000 LB LDG WT	PER 10000 LB ABV/BLW 450000 LB	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	9800	230/-210	350	-800/3800	2900/-910	150/-140	520	3630	15000
ANTISKID (FLAPS 30)	VREF30	9490	220/-210	340	-790/3770	2800/-900	150/-140	520	3340	15000
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	9060	190/-190	310	-560/2240	1020/-580	150/-140	600	-	2730
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	7860	170/-160	260	-520/2100	900/-500	130/-120	550	-	1930
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	9310	190/-180	350	-520/2080	740/-460	150/-140	520	2330	7390
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	8160	170/-160	300	-490/1990	700/-420	130/-120	510	1900	5880
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	7790	170/-160	280	-480/1960	690/-410	120/-110	500	1600	4620
FLAPS PRIMARY FAIL	VREF20	8360	180/-180	300	-510/2040	760/-500	130/-120	570	1830	5480
FLAP/SLAT CONTROL	VREF20	7670	170/-160	270	-480/1950	670/-400	120/-110	480	1530	4380
FLIGHT CONTROL MODE	VREF20	8680	190/-180	320	-520/2080	810/-480	140/-130	620	2030	6270
HYD PRESS SYS C	VREF20	8360	180/-180	300	-510/2040	760/-500	130/-120	570	1830	5480
HYD PRESS SYS L+C	VREF30+20	11510	230/-220	440	-690/2690	1580/-830	190/-180	820	-	4770
HYD PRESS SYS L+R	VREF30+20	15410	250/-240	570	-960/3630	3590/-1580	270/-270	1050	-	-
HYD PRESS SYS R+C	VREF30+20	11670	230/-230	450	-700/2710	1530/-850	200/-190	840	-	4970
HYD PRESS SYS L (FLAPS 25)	VREF25	9150	190/-180	330	-600/2420	1160/-640	150/-140	640	-	3050
HYD PRESS SYS L (FLAPS 30)	VREF30	8830	180/-170	320	-600/2390	1150/-640	140/-140	650	-	2690
HYD PRESS SYS R (FLAPS 25)	VREF25	9040	180/-180	330	-600/2400	1130/-630	150/-140	630	-	2940
HYD PRESS SYS R (FLAPS 30)	VREF30	8510	170/-170	300	-580/2340	1080/-600	140/-130	600	-	2420
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	8890	180/-170	330	-500/2030	690/-420	140/-130	470	1970	5900
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	7910	160/-160	280	-480/1960	670/-400	120/-120	470	1550	4390
PRI FLIGHT COMPUTERS	VREF20	8680	190/-180	320	-520/2080	810/-480	140/-130	620	2030	6270
SLATS DRIVE	VREF30+30	8720	180/-170	320	-510/2040	730/-440	140/-130	500	1820	5240
STABILIZER	VREF30+20	8170	170/-160	290	-500/2000	720/-430	130/-120	500	1690	4870

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (1000 ft air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION

Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 LB)			
		AIRPORT PRESSURE ALTITUDE (FT)			
		0	1000	2000	3000
54	129	509.5			
52	126	524.1	504.0		
50	122	539.1	519.0	497.5	
48	118	555.3	533.9	512.5	493.3
46	115	571.0	549.5	526.9	506.8
44	111	586.0	564.3	541.8	520.4
42	108	600.7	578.4	555.9	533.9
40	104	614.6	591.8	569.1	546.8
38	100	628.0	604.4	581.5	559.3
36	97	640.3	616.1	592.9	570.6
34	93	651.1	627.0	603.2	581.0
32	90	660.2	636.1	612.5	588.7
30	86	668.7	644.0	619.6	596.1
28	82	668.8	651.9	625.1	601.9
26	79	668.9	652.0	630.4	606.1
24	75	669.0	652.2	633.1	610.0
22	72	669.2	652.3	633.3	612.9
20	68	669.3	652.4	633.4	615.3
18	64	669.4	652.5	633.5	615.4
16	61	669.5	652.6	633.6	615.5
14	57	669.6	652.8	633.7	615.6
12	54	669.8	652.9	633.8	615.7
10 & BELOW	50 & BELOW	669.9	653.0	634.0	615.9

Based on engine bleed for 2 packs on and engine anti-ice off and wing anti-ice off.
With engine bleed for packs off, increase weight by 4800 lb.
With engine anti-ice on, decrease weight by 1100 lb.
With engine and wing anti-ice on, decrease weight by 4800 lb.
When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 43300 lb.

ADVISORY INFORMATION

Recommended Brake Cooling Schedule Reference Brake Energy (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)																							
		80			100			120			140			160			180								
WEIGHT (1000 LB)	OAT (°C)	PRESSURE ALTITUDE (1000 FT)																							
		0	2	4	0	2	4	0	2	4	0	2	4	0	2	4	0	2	4						
680	0	19.3	20.2	21.0	28.6	30.1	31.5	39.3	41.5	43.7	51.2	54.2	57.3	64.1	67.9	71.8	77.0	81.7	86.3						
	10	19.8	20.7	21.6	29.4	31.0	32.5	40.5	42.8	45.0	52.8	55.9	59.1	66.1	70.1	74.1	79.4	84.1	88.9						
	15	20.2	21.1	22.0	30.0	31.6	33.1	41.2	43.6	45.9	53.8	56.9	60.2	67.3	71.3	75.4	80.7	85.5	90.3						
	20	20.6	21.5	22.4	30.5	32.1	33.6	41.9	44.3	46.7	54.7	57.9	61.2	68.4	72.5	76.6	82.0	86.8	91.7						
	30	21.0	22.0	22.9	31.3	32.9	34.5	43.1	45.5	47.9	56.2	59.5	62.8	70.2	74.4	78.7	84.2	89.2	94.1						
	40	21.2	22.1	23.1	31.6	33.3	34.9	43.7	46.2	48.7	57.2	60.6	64.0	71.6	75.9	80.2	85.9	91.0	96.0						
640	0	18.5	19.3	20.1	27.3	28.7	30.0	37.4	39.5	41.6	48.7	51.6	54.4	60.9	64.6	68.3	73.4	77.8	82.3						
	10	19.0	19.8	20.6	28.1	29.5	30.9	38.6	40.7	42.8	50.2	53.2	56.1	62.8	66.6	70.4	75.6	80.2	84.7						
	15	19.3	20.2	21.0	28.6	30.1	31.5	39.3	41.5	43.6	51.1	54.2	57.1	63.9	67.8	71.6	76.9	81.5	86.1						
	20	19.6	20.5	21.4	29.1	30.6	32.0	39.9	42.2	44.4	52.0	55.1	58.1	65.0	68.9	72.8	78.2	82.8	87.5						
	30	20.1	21.0	21.8	29.8	31.3	32.8	41.0	43.3	45.6	53.4	56.6	59.7	66.8	70.8	74.8	80.3	85.1	89.8						
	40	20.2	21.1	22.0	30.1	31.7	33.2	41.6	43.9	46.3	54.4	57.6	60.8	68.1	72.2	76.3	81.9	86.8	91.6						
600	0	17.6	18.4	19.1	26.0	27.3	28.5	35.5	37.5	39.4	46.2	48.8	51.5	57.7	61.2	64.7	69.6	73.8	78.0						
	10	18.1	18.9	19.6	26.7	28.0	29.4	36.6	38.6	40.6	47.6	50.4	53.1	59.5	63.1	66.7	71.8	76.1	80.4						
	15	18.4	19.2	20.0	27.2	28.5	29.9	37.3	39.3	41.4	48.5	51.3	54.1	60.6	64.2	67.9	73.0	77.4	81.8						
	20	18.7	19.5	20.3	27.7	29.0	30.4	37.9	40.0	42.1	49.3	52.2	55.0	61.6	65.3	69.0	74.2	78.6	83.1						
	30	19.2	20.0	20.8	28.3	29.8	31.2	38.9	41.0	43.2	50.6	53.6	56.5	63.3	67.1	70.9	76.2	80.8	85.3						
	40	19.2	20.1	20.9	28.6	30.1	31.5	39.4	41.6	43.8	51.5	54.5	57.6	64.5	68.4	72.3	77.8	82.4	87.1						
560	0	16.8	17.5	18.2	24.6	25.8	27.0	33.6	35.4	37.2	43.6	46.1	48.6	54.4	57.7	60.9	65.7	69.7	73.7						
	10	17.2	17.9	18.7	25.3	26.6	27.8	34.6	36.5	38.4	44.9	47.5	50.1	56.1	59.5	62.8	67.7	71.8	75.9						
	15	17.5	18.3	19.0	25.8	27.1	28.3	35.3	37.2	39.1	45.8	48.4	51.0	57.1	60.6	63.9	68.9	73.1	77.2						
	20	17.8	18.6	19.3	26.3	27.5	28.8	35.9	37.8	39.7	46.6	49.2	51.9	58.1	61.6	65.0	70.1	74.3	78.5						
	30	18.2	19.0	19.8	26.9	28.2	29.5	36.8	38.8	40.8	47.8	50.6	53.3	59.7	63.3	66.8	72.0	76.3	80.6						
	40	18.3	19.1	19.9	27.1	28.5	29.8	37.3	39.3	41.4	48.6	51.4	54.2	60.8	64.5	68.1	73.4	77.8	82.3						
520	0	15.9	16.6	17.2	23.3	24.4	25.5	31.7	33.4	35.1	41.0	43.3	45.6	51.1	54.1	57.1	61.7	65.4	69.1						
	10	16.4	17.0	17.7	24.0	25.1	26.3	32.6	34.4	36.1	42.3	44.7	47.1	52.7	55.8	58.9	63.6	67.4	71.3						
	15	16.7	17.3	18.0	24.4	25.6	26.8	33.2	35.0	36.8	43.1	45.5	47.9	53.7	56.8	60.0	64.7	68.6	72.5						
	20	17.0	17.6	18.3	24.8	26.0	27.2	33.8	35.6	37.4	43.8	46.3	48.7	54.6	57.8	61.0	65.8	69.8	73.7						
	30	17.3	18.0	18.7	25.4	26.6	27.9	34.7	36.5	38.4	44.9	47.5	50.1	56.1	59.4	62.7	67.6	71.7	75.7						
	40	17.4	18.1	18.8	25.6	26.9	28.2	35.1	37.0	38.9	45.6	48.3	50.9	57.1	60.5	63.9	68.9	73.1	77.2						
480	0	15.1	15.7	16.3	22.0	23.0	24.0	29.8	31.3	32.9	38.4	40.5	42.6	47.7	50.5	53.3	57.5	61.0	64.4						
	10	15.5	16.1	16.7	22.6	23.7	24.7	30.6	32.2	33.8	39.5	41.7	44.0	49.2	52.1	54.9	59.3	62.9	66.4						
	15	15.8	16.4	17.0	23.0	24.1	25.2	31.2	32.8	34.5	40.3	42.5	44.8	50.1	53.0	55.9	60.4	64.0	67.6						
	20	16.1	16.7	17.3	23.4	24.5	25.6	31.8	33.4	35.1	41.0	43.2	45.5	50.9	53.9	56.9	61.4	65.1	68.7						
	30	16.4	17.1	17.7	24.0	25.1	26.2	32.5	34.2	36.0	42.0	44.4	46.7	52.3	55.4	58.4	63.1	66.9	70.6						
	40	16.5	17.1	17.8	24.2	25.3	26.5	32.9	34.7	36.4	42.7	45.1	47.5	53.2	56.4	59.5	64.3	68.2	72.0						
440	0	14.3	14.9	15.4	20.7	21.6	22.5	27.8	29.2	30.6	35.7	37.7	39.6	44.2	46.8	49.3	53.2	56.4	59.6						
	10	14.7	15.2	15.8	21.2	22.2	23.2	28.6	30.1	31.6	36.8	38.8	40.8	45.6	48.2	50.9	54.9	58.2	61.4						
	15	15.0	15.5	16.1	21.6	22.6	23.6	29.2	30.7	32.2	37.5	39.5	41.6	46.4	49.1	51.8	55.9	59.2	62.5						
	20	15.2	15.8	16.4	22.0	23.0	24.0	29.7	31.2	32.7	38.1	40.2	42.3	47.2	49.9	52.7	56.8	60.2	63.6						
	30	15.5	16.1	16.7	22.5	23.5	24.6	30.4	32.0	33.5	39.1	41.2	43.4	48.5	51.3	54.1	58.4	61.9	65.3						
	40	15.6	16.2	16.8	22.7	23.7	24.8	30.7	32.3	33.9	39.6	41.9	44.1	49.3	52.2	55.1	59.5	63.0	66.6						

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.

If ground speed is used for brakes on speed, ignore wind and enter table with sea level, 15°C.

ADVISORY INFORMATION**Recommended Brake Cooling Schedule****Event Adjusted Brake Energy (Millions of Foot Pounds)****No Reverse Thrust**

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)									
EVENT		10	20	30	40	50	60	70	80	90	100
LANDING	RTO MAX MAN	10	20	30	40	50	60	70	80	90	100
	MAX MAN	5.1	14.1	23.1	32.1	41.2	50.3	59.5	68.8	78.3	87.9
	MAX AUTO	5.1	13.1	21.2	29.6	38.1	46.9	56.0	65.5	75.3	85.6
	AUTOBRAKE 4	4.9	12.4	19.9	27.5	35.4	43.5	52.1	61.1	70.6	80.8
	AUTOBRAKE 3	4.6	11.6	18.5	25.5	32.7	40.1	47.9	56.2	65.0	74.5
	AUTOBRAKE 2	4.3	10.8	17.2	23.6	30.1	36.9	43.9	51.4	59.4	68.0
	AUTOBRAKE 1	4.2	10.1	15.9	21.8	27.7	33.8	40.3	47.1	54.5	62.4

2 Engine Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)									
EVENT		10	20	30	40	50	60	70	80	90	100
LANDING	RTO MAX MAN	10	20	30	40	50	60	70	80	90	100
	MAX MAN	4.4	13.0	21.4	29.7	37.9	46.1	54.3	62.6	71.1	79.7
	MAX AUTO	2.4	9.4	16.4	23.5	30.9	38.6	46.6	55.0	64.0	73.5
	AUTOBRAKE 4	1.9	7.2	12.7	18.4	24.5	31.0	37.9	45.5	53.6	62.5
	AUTOBRAKE 3	1.1	4.9	9.0	13.4	18.2	23.4	29.0	35.2	42.0	49.3
	AUTOBRAKE 2	0.3	3.1	6.1	9.4	13.0	16.9	21.3	26.1	31.4	37.2
	AUTOBRAKE 1	0.1	2.3	4.6	7.1	9.8	12.7	16.1	19.9	24.2	29.2

Cooling Time (Minutes)

		EVENT ADJUSTED BRAKE ENERGY (MILLIONS OF FOOT POUNDS)									
		16 & BELOW	17	18	20	24	28	32	35	36 TO 44	45 & ABOVE
GEAR DOWN	NO SPECIAL	PROCEDURE REQUIRED	1.0	1.6	2.6	4.2	5.5	6.6	7.3	CAUTION	FUSE PLUG MELT ZONE
INFLIGHT											
GROUND			10	16	26	42	55	66	73		
BTMS	UP TO 2.4		2.4	2.6	2.9	3.4	4.0	4.5	4.9	5.0 TO 6.3	6.3 & ABOVE

Observe maximum quick turnaround limit.

Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.

Add 1.0 million foot pounds for each taxi mile.

For one brake deactivated, increase brake energy by 10 percent.

For two brakes deactivated, increase brake energy by 20 percent.

When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after one hour. If overheat occurs after takeoff, extend gear soon for at least 8 minutes.

When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not attempt to taxi for one hour. Tire, wheel and brake replacement may be required. If overheat occurs after takeoff, extend gear soon for at least 12 minutes.

Brake temperature monitor system (BTMS) indication on EICAS may be used 12 to 15 minutes after airplane has come to a complete stop, or inflight with gear retracted, to determine recommended cooling schedule. (Inflight gear extended, the BTMS indications may vary between individual brakes, due to airstream effects, gear tilt, and position of the gear temperature probes.)

Performance Inflight
Engine Inoperative

Chapter PI
Section 53

ENGINE INOP

Initial Max Continuous EPR
Based on .84M, engine bleed for packs on or off and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	1.260	1.236	1.217	1.204	1.193	1.176	1.182	1.192	1.203
15	1.320	1.295	1.272	1.256	1.244	1.224	1.229	1.237	1.245
10	1.376	1.351	1.328	1.311	1.295	1.275	1.280	1.285	1.290
5	1.378	1.404	1.382	1.365	1.352	1.329	1.333	1.335	1.337
0	1.378	1.420	1.431	1.415	1.402	1.381	1.385	1.385	1.384
-5	1.378	1.420	1.460	1.460	1.488	1.429	1.433	1.431	1.430
-10	1.378	1.420	1.460	1.482	1.488	1.472	1.475	1.473	1.472
-15	1.378	1.420	1.460	1.482	1.504	1.505	1.506	1.505	1.504
-20	1.378	1.420	1.460	1.482	1.504	1.505	1.506	1.505	1.504
-25	1.378	1.420	1.460	1.482	1.504	1.505	1.506	1.505	1.504
-30	1.378	1.420	1.460	1.482	1.504	1.505	1.506	1.505	1.504
-35	1.378	1.420	1.460	1.482	1.504	1.505	1.506	1.505	1.504
-40	1.378	1.420	1.460	1.482	1.504	1.505	1.506	1.505	1.504

ENGINE INOP

**Max Continuous EPR
37000 FT to 31000 FT Pressure Altitudes**

37000 FT PRESS ALT			TAT (°C)										
KLAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
150	0.48	1.480	1.480	1.480	1.477	1.464	1.445	1.421	1.392	1.359	1.326	1.324	1.324
200	0.63	1.495	1.495	1.495	1.495	1.495	1.480	1.453	1.419	1.379	1.336	1.292	1.258
250	0.77	1.530	1.530	1.530	1.530	1.530	1.530	1.530	1.499	1.460	1.416	1.367	1.316
300	0.91	1.463	1.463	1.463	1.463	1.463	1.463	1.463	1.463	1.463	1.434	1.393	1.346
35000 FT PRESS ALT			TAT (°C)										
KLAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
150	0.46	1.479	1.479	1.479	1.479	1.464	1.445	1.421	1.392	1.362	1.332	1.323	1.323
200	0.60	1.484	1.484	1.484	1.484	1.484	1.473	1.451	1.421	1.385	1.350	1.315	1.283
250	0.74	1.528	1.528	1.528	1.528	1.528	1.528	1.528	1.498	1.459	1.413	1.360	1.303
300	0.87	1.480	1.480	1.480	1.480	1.480	1.480	1.480	1.480	1.480	1.448	1.404	1.355
33000 FT PRESS ALT			TAT (°C)										
KLAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
150	0.44	1.486	1.486	1.486	1.486	1.480	1.460	1.435	1.407	1.375	1.345	1.317	1.317
200	0.58	1.493	1.493	1.493	1.493	1.493	1.493	1.471	1.444	1.409	1.372	1.336	1.299
250	0.71	1.530	1.530	1.530	1.530	1.530	1.530	1.530	1.516	1.478	1.430	1.370	1.301
300	0.84	1.482	1.482	1.482	1.482	1.482	1.482	1.482	1.482	1.482	1.460	1.415	1.365
330	0.91	1.439	1.439	1.439	1.439	1.439	1.439	1.439	1.439	1.439	1.439	1.426	1.383
31000 FT PRESS ALT			TAT (°C)										
KLAS	M	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10
150	0.42	1.492	1.492	1.492	1.492	1.478	1.453	1.425	1.393	1.362	1.333	1.315	1.315
200	0.55	1.506	1.506	1.506	1.506	1.506	1.497	1.470	1.438	1.400	1.361	1.322	1.284
250	0.68	1.530	1.530	1.530	1.530	1.530	1.530	1.530	1.498	1.454	1.395	1.326	1.262
300	0.81	1.482	1.482	1.482	1.482	1.482	1.482	1.482	1.482	1.477	1.435	1.386	1.334
333	0.88	1.432	1.432	1.432	1.432	1.432	1.432	1.432	1.432	1.432	1.432	1.385	1.335

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)			
	31	33	35	37
ENGINE ONLY	-0.018	-0.017	-0.016	-0.017
ENGINE & WING *	-0.033	-0.032	-0.032	-0.034
ENGINE & WING **	-0.048	-0.047	-0.048	-0.051

*Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

ENGINE INOP

Max Continuous EPR

29000 FT to 24000 FT Pressure Altitudes

29000 FT PRESS ALT		TAT (°C)											
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
150	0.40	1.504	1.504	1.504	1.504	1.488	1.459	1.429	1.394	1.363	1.334	1.326	1.326
200	0.53	1.509	1.509	1.509	1.509	1.509	1.497	1.464	1.427	1.388	1.350	1.313	1.293
250	0.65	1.504	1.504	1.504	1.504	1.504	1.504	1.504	1.457	1.405	1.350	1.294	1.251
300	0.78	1.466	1.466	1.466	1.466	1.466	1.466	1.466	1.466	1.450	1.397	1.340	1.281
330	0.85	1.417	1.417	1.417	1.417	1.417	1.417	1.417	1.417	1.417	1.406	1.354	1.298
27000 FT PRESS ALT		TAT (°C)											
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
150	0.38	1.523	1.523	1.523	1.523	1.523	1.505	1.473	1.440	1.404	1.372	1.343	1.343
200	0.51	1.512	1.512	1.512	1.512	1.512	1.512	1.496	1.458	1.416	1.376	1.341	1.306
250	0.63	1.479	1.479	1.479	1.479	1.479	1.479	1.479	1.474	1.423	1.372	1.325	1.285
300	0.75	1.450	1.450	1.450	1.450	1.450	1.450	1.450	1.450	1.450	1.417	1.350	1.288
330	0.81	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.370	1.311
25000 FT PRESS ALT		TAT (°C)											
KIAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
150	0.37	1.540	1.540	1.540	1.540	1.540	1.522	1.488	1.451	1.415	1.380	1.360	1.360
200	0.49	1.511	1.511	1.511	1.511	1.511	1.511	1.490	1.447	1.404	1.366	1.332	1.307
250	0.60	1.461	1.461	1.461	1.461	1.461	1.461	1.461	1.451	1.400	1.354	1.315	1.282
300	0.72	1.429	1.429	1.429	1.429	1.429	1.429	1.429	1.429	1.429	1.371	1.302	1.248
330	0.78	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.327	1.260
24000 FT PRESS ALT		TAT (°C)											
KIAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
150	0.36	1.536	1.536	1.536	1.536	1.536	1.530	1.494	1.459	1.421	1.387	1.355	1.355
200	0.48	1.507	1.507	1.507	1.507	1.507	1.507	1.497	1.455	1.412	1.372	1.339	1.307
250	0.59	1.463	1.463	1.463	1.463	1.463	1.463	1.463	1.453	1.408	1.363	1.324	1.289
300	0.70	1.432	1.432	1.432	1.432	1.432	1.432	1.432	1.432	1.424	1.381	1.310	1.257
333	0.77	1.382	1.382	1.382	1.382	1.382	1.382	1.382	1.382	1.382	1.378	1.336	1.270

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)			
	24	25	27	29
ENGINE ONLY	-0.022	-0.023	-0.021	-0.020
ENGINE & WING*	-0.037	-0.038	-0.036	-0.035
ENGINE & WING**	-0.051	-0.053	-0.051	-0.050

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

ENGINE INOP

Max Continuous EPR

22000 FT to 16000 FT Pressure Altitudes

22000 FT PRESS ALT			TAT (°C)										
CIAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
150	0.35	1.529	1.529	1.529	1.529	1.529	1.511	1.474	1.399	1.399	1.367	1.346	1.346
200	0.46	1.500	1.500	1.500	1.500	1.500	1.496	1.470	1.428	1.389	1.353	1.322	1.301
250	0.57	1.466	1.466	1.466	1.466	1.466	1.466	1.455	1.423	1.380	1.339	1.302	1.270
300	0.68	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.424	1.387	1.325	1.273	1.234
330	0.74	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.386	1.347	1.283	1.228
20000 FT PRESS ALT			TAT (°C)										
CIAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
150	0.33	1.523	1.523	1.523	1.523	1.523	1.523	1.493	1.453	1.412	1.378	1.347	1.336
200	0.44	1.492	1.492	1.492	1.492	1.492	1.492	1.484	1.444	1.404	1.365	1.334	1.305
250	0.55	1.465	1.465	1.465	1.465	1.465	1.465	1.465	1.435	1.395	1.355	1.317	1.285
300	0.65	1.425	1.425	1.425	1.425	1.425	1.425	1.425	1.425	1.393	1.338	1.291	1.250
330	0.71	1.394	1.394	1.394	1.394	1.394	1.394	1.394	1.394	1.394	1.351	1.291	1.238
18000 FT PRESS ALT			TAT (°C)										
CIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
150	0.32	1.496	1.496	1.496	1.496	1.496	1.494	1.455	1.415	1.380	1.351	1.322	1.321
200	0.42	1.474	1.474	1.474	1.474	1.474	1.471	1.452	1.409	1.369	1.336	1.309	1.283
250	0.53	1.498	1.498	1.498	1.498	1.498	1.498	1.485	1.429	1.373	1.325	1.288	1.260
300	0.63	1.461	1.461	1.461	1.461	1.461	1.461	1.461	1.461	1.398	1.337	1.285	1.238
330	0.69	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.415	1.352	1.293	1.240
16000 FT PRESS ALT			TAT (°C)										
CIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
150	0.31	1.473	1.473	1.473	1.473	1.473	1.472	1.456	1.418	1.383	1.353	1.326	1.306
200	0.41	1.454	1.454	1.454	1.454	1.454	1.454	1.442	1.412	1.375	1.342	1.314	1.288
250	0.51	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.465	1.408	1.354	1.309	1.273
300	0.60	1.465	1.465	1.465	1.465	1.465	1.465	1.465	1.465	1.436	1.375	1.318	1.271
330	0.66	1.423	1.423	1.423	1.423	1.423	1.423	1.423	1.423	1.423	1.381	1.321	1.267

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)			
	16	18	20	22
ENGINE ONLY	-0.011	-0.014	-0.018	-0.020
ENGINE & WING*	-0.022	-0.026	-0.031	-0.034
ENGINE & WING**	-0.033	-0.038	-0.044	-0.047

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

ENGINE INOP

Max Continuous EPR

14000 FT to 5000 FT Pressure Altitudes

14000 FT PRESS ALT		TAT (°C)											
KIAS	M	-20	-15	-10	-5	0	5	10	15	20	25	30	35
150	0.29	1.446	1.446	1.446	1.446	1.446	1.443	1.417	1.381	1.351	1.325	1.301	1.290
200	0.39	1.437	1.437	1.437	1.437	1.437	1.437	1.407	1.372	1.341	1.315	1.291	1.267
250	0.49	1.490	1.490	1.490	1.490	1.490	1.490	1.490	1.435	1.379	1.329	1.286	1.252
300	0.58	1.466	1.466	1.466	1.466	1.466	1.466	1.466	1.466	1.410	1.350	1.300	1.256
330	0.64	1.425	1.425	1.425	1.425	1.425	1.425	1.425	1.425	1.416	1.354	1.298	1.250
12000 FT PRESS ALT		TAT (°C)											
KIAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40
150	0.28	1.444	1.444	1.444	1.444	1.444	1.431	1.415	1.388	1.351	1.317	1.285	1.278
200	0.38	1.433	1.433	1.433	1.433	1.433	1.430	1.415	1.397	1.367	1.325	1.285	1.247
250	0.47	1.478	1.478	1.478	1.478	1.478	1.478	1.462	1.416	1.371	1.329	1.289	1.252
300	0.56	1.471	1.471	1.471	1.471	1.471	1.471	1.471	1.453	1.393	1.338	1.293	1.254
330	0.62	1.439	1.439	1.439	1.439	1.439	1.439	1.439	1.439	1.403	1.344	1.294	1.251
10000 FT PRESS ALT		TAT (°C)											
KIAS	M	-15	-10	5	0	5	10	15	20	25	30	35	40
150	0.27	1.425	1.425	1.425	1.425	1.425	1.422	1.403	1.384	1.355	1.320	1.299	1.280
200	0.36	1.401	1.401	1.401	1.401	1.401	1.401	1.394	1.380	1.358	1.323	1.291	1.270
250	0.45	1.411	1.411	1.411	1.411	1.411	1.411	1.411	1.387	1.353	1.318	1.282	1.252
300	0.54	1.411	1.411	1.411	1.411	1.411	1.411	1.411	1.411	1.372	1.323	1.282	1.254
330	0.59	1.383	1.383	1.383	1.383	1.383	1.383	1.383	1.383	1.382	1.327	1.285	1.246
5000 FT PRESS ALT		TAT (°C)											
KIAS	M	-10	-5	0	5	10	15	20	25	30	35	40	45
150	0.25	1.385	1.385	1.385	1.385	1.385	1.385	1.377	1.348	1.323	1.302	1.281	1.260
200	0.33	1.367	1.367	1.367	1.367	1.367	1.367	1.367	1.353	1.336	1.316	1.291	1.265
250	0.41	1.341	1.341	1.341	1.341	1.341	1.341	1.341	1.341	1.326	1.311	1.287	1.253
300	0.49	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.333	1.327	1.289	1.254	1.221
330	0.54	1.311	1.311	1.311	1.311	1.311	1.311	1.311	1.311	1.311	1.289	1.252	1.218

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)			
	5	10	12	14
ENGINE ONLY	-0.015	-0.015	-0.013	-0.010
ENGINE & WING*	-0.023	-0.025	-0.023	-0.020
ENGINE & WING**	-0.031	-0.035	-0.033	-0.030

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

Includes APU fuel burn

WEIGHT (1000 LB)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
660	638	281	16200	14700	13100
620	600	273	17700	16300	14700
580	562	264	19000	18000	16400
540	522	255	20400	19600	18300
500	483	246	22300	21700	20500
460	444	236	24300	24100	22900
420	406	226	26400	26200	25300
380	367	215	28700	28300	27500
340	329	204	31200	30600	29900

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
134	125	118	111	105	100	95	91	87	83	80
274	255	239	224	211	200	190	181	172	165	158
413	384	359	337	317	300	284	270	258	246	236
551	512	479	449	423	400	379	360	343	328	314
688	640	598	561	529	500	474	451	429	410	393
825	768	717	674	635	600	569	541	516	492	471
961	895	836	785	740	700	664	631	602	575	550
1097	1021	955	897	846	800	759	722	688	658	629
1233	1148	1074	1009	951	900	854	812	775	740	709
1368	1274	1192	1121	1057	1000	949	903	861	823	788
1503	1401	1311	1232	1162	1100	1044	993	947	906	867
1639	1527	1430	1344	1268	1200	1139	1084	1034	988	947
1774	1654	1548	1456	1373	1300	1234	1174	1120	1071	1026
1910	1781	1667	1567	1479	1400	1329	1265	1207	1153	1105
2047	1908	1786	1679	1585	1500	1424	1355	1293	1236	1184
2184	2035	1906	1792	1690	1600	1519	1445	1379	1318	1263
2321	2163	2025	1904	1796	1700	1614	1536	1465	1400	1341
2460	2292	2145	2016	1902	1800	1708	1626	1550	1482	1419

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 LB)									TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 LB)									
	340	380	420	460	500	540	580	620	660	
100	2.1	2.3	2.5	2.8	3.0	3.2	3.2	3.4	3.6	0:15
200	4.9	5.4	5.8	6.3	6.8	7.2	7.5	8.0	8.6	0:32
300	8.0	8.8	9.5	10.3	11.1	11.9	12.5	13.4	14.2	0:49
400	11.2	12.3	13.4	14.5	15.6	16.7	17.7	18.9	20.1	1:06
500	14.2	15.7	17.1	18.5	20.0	21.4	22.6	24.2	25.8	1:22
600	17.2	19.0	20.7	22.4	24.1	25.9	27.4	29.3	31.2	1:38
700	20.2	22.2	24.2	26.2	28.3	30.4	32.2	34.4	36.5	1:54
800	23.1	25.4	27.7	30.0	32.4	34.8	36.9	39.4	41.8	2:10
900	26.0	28.6	31.2	33.8	36.4	39.1	41.6	44.4	47.1	2:26
1000	28.8	31.7	34.6	37.5	40.5	43.4	46.2	49.4	52.3	2:41
1100	31.6	34.8	38.0	41.2	44.4	47.7	50.8	54.2	57.5	2:57
1200	34.4	37.9	41.4	44.8	48.4	51.9	55.3	59.1	62.6	3:13
1300	37.1	40.9	44.7	48.4	52.2	56.1	59.8	63.8	67.7	3:29
1400	39.8	43.9	47.9	52.0	56.1	60.2	64.2	68.6	72.7	3:44
1500	42.5	46.9	51.2	55.5	59.9	64.3	68.6	73.3	77.6	4:00
1600	45.1	49.8	54.4	59.0	63.7	68.4	73.0	77.9	82.5	4:17
1700	47.8	52.7	57.6	62.5	67.4	72.4	77.3	82.5	87.4	4:33
1800	50.3	55.5	60.7	65.9	71.1	76.4	81.5	87.0	92.2	4:50

Includes APU fuel burn.

Driftdown at optimum driftdown speed and cruise at LRC speed.

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
660	13200	12000	7600
640	14000	12800	9700
620	14800	13600	12200
600	15700	14400	13000
580	16500	15300	13800
560	17400	16200	14700
540	18300	17100	15600
520	19000	18000	16600
500	19700	18800	17600
480	20600	19600	18600
460	21600	20700	19700
440	22700	22000	20900
420	23700	23300	22200
400	24900	24800	23600
380	26100	25900	24900
360	27400	27100	26200
340	28800	28400	27500

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)									
		10	13	15	17	19	21	23	25	27	29
660	EPR	1.263	1.355								
	MACH	.577	.615								
	KIAS	321	323								
	FF/ENG	20270	21145								
620	EPR	1.235	1.302	1.379							
	MACH	.567	.591	.622							
	KIAS	315	310	315							
	FF/ENG	19027	19136	20113							
580	EPR	1.209	1.263	1.315	1.404						
	MACH	.555	.575	.595	.628						
	KIAS	308	302	301	306						
	FF/ENG	17754	17668	17936	19053						
540	EPR	1.185	1.233	1.270	1.327	1.426					
	MACH	.541	.564	.577	.599	.633					
	KIAS	300	296	292	292	297					
	FF/ENG	16495	16470	16382	16765	17916					
500	EPR	1.164	1.204	1.236	1.274	1.336					
	MACH	.526	.549	.564	.578	.601					
	KIAS	292	288	285	281	281					
	FF/ENG	15293	15222	15189	15142	15546					
460	EPR	1.145	1.179	1.205	1.235	1.274	1.342				
	MACH	.512	.532	.548	.564	.577	.601				
	KIAS	284	279	277	274	270	270				
	FF/ENG	14164	14013	13947	13934	13868	14271				
420	EPR	1.127	1.157	1.178	1.201	1.233	1.273	1.342	1.448		
	MACH	.497	.516	.530	.546	.563	.576	.599	.634		
	KIAS	275	270	267	265	263	259	258	263		
	FF/ENG	13077	12883	12744	12662	12641	12582	12936	13947		
380	EPR	1.110	1.136	1.154	1.172	1.198	1.231	1.274	1.333	1.440	
	MACH	.482	.499	.513	.527	.543	.559	.574	.594	.630	
	KIAS	267	261	258	255	253	251	247	246	250	
	FF/ENG	12119	11793	11631	11445	11375	11331	11311	11574	12465	
340	EPR	1.092	1.116	1.131	1.146	1.168	1.193	1.227	1.267	1.321	1.419
	MACH	.461	.483	.495	.508	.522	.537	.554	.570	.587	.620
	KIAS	255	253	249	246	243	240	238	235	233	236
	FF/ENG	11113	10789	10555	10335	10202	10115	10047	10033	10187	10906

ENGINE INOP

MAX CONTINUOUS THRUST

**Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
288	265	245	228	213	200	190	181	173	165	158
573	528	489	455	426	400	380	362	346	331	318
860	793	734	683	639	600	571	544	519	497	477
1147	1057	978	911	852	800	761	725	692	662	635
1435	1323	1224	1139	1066	1000	951	906	865	828	794
1724	1589	1469	1367	1279	1200	1141	1086	1037	992	952
2014	1856	1716	1596	1493	1400	1331	1268	1210	1157	1109
2305	2123	1962	1825	1706	1600	1521	1448	1381	1321	1266
2596	2391	2208	2054	1920	1800	1710	1628	1552	1484	1423

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)							
	10		14		18		22	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	8.6	0:40	7.5	0:39	6.8	0:38	6.5	0:36
300	13.1	0:58	11.9	0:56	11.0	0:54	10.9	0:51
400	17.7	1:16	16.2	1:13	15.2	1:11	15.2	1:06
500	22.3	1:34	20.6	1:31	19.4	1:28	19.4	1:22
600	26.8	1:52	24.9	1:48	23.5	1:44	23.6	1:37
700	31.3	2:10	29.2	2:05	27.6	2:01	27.8	1:53
800	35.8	2:29	33.4	2:23	31.7	2:18	31.9	2:08
900	40.2	2:47	37.7	2:41	35.7	2:35	35.9	2:24
1000	44.6	3:05	41.9	2:58	39.8	2:52	40.0	2:40
1100	49.0	3:24	46.1	3:16	43.8	3:09	43.9	2:56
1200	53.4	3:42	50.2	3:34	47.8	3:26	47.9	3:12
1300	57.8	4:01	54.4	3:52	51.7	3:43	51.8	3:28
1400	62.1	4:19	58.5	4:09	55.7	4:00	55.7	3:44
1500	66.4	4:38	62.6	4:27	59.6	4:17	59.5	4:01
1600	70.7	4:57	66.7	4:45	63.5	4:34	63.3	4:17
1700	75.0	5:16	70.7	5:03	67.3	4:52	67.0	4:33
1800	79.2	5:35	74.8	5:22	71.2	5:09	70.8	4:50

ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time
Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)							
	300	350	400	450	500	550	600	650
5	-0.7	-0.6	-0.4	-0.2	0.0	0.5	0.8	1.2
10	-1.7	-1.4	-1.0	-0.5	0.0	1.3	2.3	3.1
15	-2.8	-2.2	-1.5	-0.8	0.0	2.1	3.7	5.1
20	-3.8	-3.0	-2.1	-1.1	0.0	2.8	5.2	7.0
25	-4.9	-3.8	-2.6	-1.3	0.0	3.6	6.6	9.0
30	-5.9	-4.6	-3.1	-1.6	0.0	4.3	8.0	10.9
35	-6.9	-5.3	-3.6	-1.9	0.0	5.1	9.3	12.9
40	-7.9	-6.1	-4.2	-2.1	0.0	5.8	10.7	14.8
45	-9.0	-6.9	-4.7	-2.4	0.0	6.5	12.0	16.7
50	-10.0	-7.6	-5.2	-2.7	0.0	7.1	13.4	18.7
55	-11.0	-8.4	-5.7	-2.9	0.0	7.8	14.7	20.6
60	-12.0	-9.1	-6.2	-3.2	0.0	8.5	16.0	22.5
65	-13.0	-9.9	-6.6	-3.4	0.0	9.1	17.2	24.4
70	-14.0	-10.6	-7.1	-3.7	0.0	9.7	18.5	26.4
75	-15.0	-11.3	-7.6	-3.9	0.0	10.3	19.7	28.3
80	-16.0	-12.0	-8.0	-4.2	0.0	10.9	20.9	30.2

APU fuel included

ENGINE INOP
MAX CONTINUOUS THRUST

**Holding
Flaps Up**

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
660	EPR	1.150	1.186	1.256	1.382		
	KIAS	259	260	261	277		
	FF/ENG	17910	17770	18030	19530		
620	EPR	1.136	1.168	1.231	1.333		
	KIAS	251	252	253	262		
	FF/ENG	16750	16610	16750	17560		
580	EPR	1.122	1.152	1.208	1.294		
	KIAS	243	244	245	248		
	FF/ENG	15690	15450	15560	15900		
540	EPR	1.109	1.136	1.186	1.261	1.400	
	KIAS	234	235	236	237	252	
	FF/ENG	14630	14330	14410	14510	16030	
500	EPR	1.097	1.120	1.165	1.229	1.334	
	KIAS	226	226	227	228	235	
	FF/ENG	13600	13270	13270	13280	14050	
460	EPR	1.085	1.105	1.144	1.199	1.283	1.470
	KIAS	220	220	220	220	220	238
	FF/ENG	12610	12350	12200	12140	12400	14260
420	EPR	1.073	1.090	1.124	1.171	1.241	1.371
	KIAS	213	213	213	213	213	220
	FF/ENG	11610	11430	11230	11090	11140	12000
380	EPR	1.061	1.076	1.105	1.145	1.201	1.303
	KIAS	206	206	206	206	206	206
	FF/ENG	10630	10450	10290	10050	10030	10340
340	EPR	1.051	1.063	1.087	1.121	1.164	1.252
	KIAS	199	199	199	199	199	199
	FF/ENG	9660	9480	9370	9050	9000	9150

ENGINE INOP

ADVISORY INFORMATION

Gear Down Landing Rate of Climb Available Flaps 20

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	290	160				
50	340	210	70			
48	400	260	120			
46	450	310	170	30		
44	500	360	220	80		
42	550	410	270	130	-20	
40	600	460	310	170	20	
38	620	510	360	210	60	-100
36	620	550	400	250	100	-60
34	620	590	430	280	130	-20
32	620	620	460	320	160	-10
30	630	650	490	340	180	0
20	640	660	550	410	240	60
10	650	680	560	430	280	100
0	670	690	570	440	290	120
-20	700	720	600	460	300	130
-40	730	750	620	480	320	130

Rate of climb capability shown is valid for 450000 lb, gear down at VREF20 + 5.

Decrease rate of climb 40 ft/min per 10000 lb greater than 450000 lb.

Increase rate of climb 50 ft/min per 10000 lb less than 450000 lb.

Flaps 30

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	-200	-330				
50	-150	-290	-420			
48	-100	-240	-380			
46	-50	-190	-330	-470		
44	-10	-150	-290	-430		
42	40	-110	-250	-390	-540	
40	80	-60	-210	-350	-500	
38	90	-20	-170	-320	-460	-620
36	90	20	-130	-280	-430	-590
34	90	50	-100	-250	-400	-560
32	90	80	-70	-220	-380	-550
30	90	110	-50	-200	-360	-540
20	100	110	-10	-150	-320	-500
10	100	110	-10	-140	-290	-460
0	110	110	-10	-140	-290	-460
-20	110	120	-10	-140	-300	-470
-40	120	130	0	-150	-310	-490

Rate of climb capability shown is valid for 450000 lb, gear down at VREF30 + 5.

Decrease rate of climb 40 ft/min per 10000 lb greater than 450000 lb.

Increase rate of climb 50 ft/min per 10000 lb less than 450000 lb.

Intentionally
Blank

Performance Inflight

Alternate Mode EEC

Chapter PI

Section 54

ALTERNATE MODE EEC

Limit Weight

PERFORMANCE LIMIT	ALTERNATE MODE EEC LIMIT WEIGHT (1000 LB)							
	PRIMARY MODE PERFORMANCE LIMIT WEIGHT (1000 LB)							
	350	400	450	500	550	600	650	700
FIELD	322.5	368.5	416.5	462.0	508.5	555.5	584.5	653.0
CLIMB	301.5	344.5	387.0	431.0	474.5	517.5	562.0	605.0
OBSTACLE	312.0	356.0	398.5	441.0	485.5	528.0	572.0	615.0
NET LEVEL OFF WEIGHT		333.5	378.0	423.5	469.0	514.0	559.0	604.5
LANDING CLIMB			404.5	454.5	503.5	553.0	603.0	655.0

Takeoff Speed Adjustment

TAKEOFF SPEEDS	TAKEOFF SPEED ADJUSTMENT (KTS)
V1	+2
VR	+1
V2	0

Max Takeoff %N1

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)											
°C	°F	-2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
55	131	88.6	88.5	88.5	88.7	88.7	88.8	88.9	89.0	89.0	89.0	89.3	89.5
50	122	90.3	90.3	90.1	90.1	90.1	90.2	90.3	90.5	90.5	90.6	90.9	91.2
45	113	92.2	92.2	92.1	92.0	92.0	91.9	91.8	91.9	92.0	92.2	92.6	92.9
40	104	94.1	94.1	94.2	94.2	94.1	94.0	93.8	93.9	93.7	93.7	94.1	94.6
35	95	94.4	96.8	96.4	96.5	96.4	96.2	96.7	96.3	96.1	96.0	95.6	96.0
30	86	94.3	98.5	98.2	98.2	97.8	97.8	97.8	97.6	97.6	97.1	96.6	96.3
25	77	93.7	98.5	98.8	98.8	98.4	98.2	98.0	97.9	97.8	97.4	96.9	96.5
20	68	92.9	98.4	98.8	98.8	98.8	98.4	98.2	98.1	98.0	97.5	97.1	96.6
15	59	92.1	97.6	98.2	98.8	98.6	98.5	98.4	98.3	98.2	97.7	97.3	96.8
10	50	91.3	96.7	97.3	97.9	98.4	98.5	98.5	98.4	98.4	97.9	97.5	97.0
5	41	90.5	95.9	96.5	97.1	97.5	98.0	98.4	98.4	98.4	98.1	97.7	97.2
0	32	89.7	95.0	95.6	96.2	96.7	97.1	97.5	97.9	98.2	98.1	97.7	97.3
-10	14	88.0	93.2	93.8	94.4	94.9	95.3	95.7	96.0	96.4	96.5	96.5	96.6
-20	-4	86.4	91.5	92.0	92.6	93.0	93.5	93.9	94.2	94.6	94.6	94.7	94.7
-30	-22	84.6	89.6	90.2	90.7	91.2	91.6	92.0	92.3	92.7	92.7	92.8	92.8
-40	-40	82.9	87.8	88.3	88.9	89.3	89.7	90.1	90.4	90.8	90.8	90.8	90.9
-50	-58	81.1	85.9	86.4	86.9	87.4	87.8	88.1	88.4	88.8	88.8	88.9	88.9

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)						
	-1000	0	2000	4000	6000	8000	9000
PACKS OFF	0.8	0.8	0.9	1.0	1.0	1.1	1.1
WING ANTI-ICE ON	-0.4	-0.4	-0.5	-0.5	-0.5	-0.6	-0.6

ALTERNATE MODE EEC

Max Climb %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)									
	0	5	10	15	20	25	30	35	40	43
	310	310	310	310	310	310	310	0.84	0.84	0.84
60	85.1	85.5	87.4	89.5	90.9	89.6	90.6	93.8	94.5	95.1
50	86.3	86.6	87.1	88.1	89.6	88.3	89.3	92.4	93.0	93.6
40	86.6	87.6	88.0	88.6	88.5	86.9	87.9	91.0	91.6	92.2
30	85.2	87.5	89.4	89.9	89.4	87.8	87.0	89.5	90.1	90.7
20	83.7	86.0	88.6	91.4	91.0	90.4	89.9	88.8	88.6	89.2
15	83.0	85.3	87.8	90.7	92.2	92.0	91.3	90.0	89.6	90.0
10	82.3	84.5	87.1	89.9	91.7	94.0	92.7	91.1	90.6	90.9
5	81.6	83.8	86.3	89.1	90.8	94.3	93.8	92.3	91.7	91.8
0	80.8	83.0	85.5	88.3	90.0	93.5	95.0	93.3	92.7	92.6
-5	80.1	82.3	84.7	87.5	89.2	92.6	94.8	94.4	93.7	93.6
-10	79.3	81.5	83.9	86.6	88.4	91.8	93.9	95.2	94.6	94.5
-15	78.6	80.7	83.1	85.8	87.5	90.9	93.0	94.9	95.0	95.0
-20	77.8	79.9	82.3	85.0	86.7	90.0	92.1	94.0	94.1	94.0
-25	77.0	79.1	81.5	84.1	85.8	89.1	91.2	93.1	93.2	93.1
-30	76.3	78.3	80.7	83.3	84.9	88.2	90.3	92.1	92.2	92.2
-35	75.5	77.5	79.8	82.4	84.1	87.3	89.3	91.2	91.3	91.2
-40	74.7	76.7	79.0	81.5	83.2	86.4	88.4	90.2	90.3	90.2

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)									
	0	5	10	15	20	25	30	35	40	43
ENGINE ANTI-ICE ON	-1.0	-0.9	-0.8	-0.4	-0.7	-0.8	-0.8	-0.7	-0.8	-0.9
ENGINE & WING ANTI-ICE ON	-1.4	-1.3	-1.3	-1.0	-1.3	-1.4	-1.5	-1.3	-1.6	-1.7

Max Cruise %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (FT)									
	25000	27000	29000	31000	33000	35000	37000	39000	41000	43000
25	87.0	86.7	86.9	86.7	86.3	86.9	87.1	87.3	87.6	87.9
20	88.2	88.0	88.1	87.6	87.3	86.9	86.3	86.5	86.9	87.2
15	89.4	89.3	89.3	88.6	88.1	87.7	87.1	87.3	87.5	87.7
10	91.0	90.4	90.2	89.6	89.1	88.6	87.9	88.1	88.3	88.4
5	91.1	91.6	91.1	90.5	90.0	89.6	88.8	89.0	89.0	89.1
0	90.3	91.1	91.8	91.3	90.7	90.3	89.7	89.8	89.8	89.8
-5	89.5	90.3	91.0	91.4	91.4	91.0	90.4	90.5	90.4	90.4
-10	88.6	89.4	90.1	90.5	91.3	91.5	90.9	91.0	91.0	90.9
-15	87.8	88.6	89.2	89.7	90.4	91.2	91.3	91.4	91.3	91.3
-20	86.9	87.7	88.4	88.8	89.5	90.3	90.4	90.5	90.4	90.4
-25	86.1	86.8	87.5	87.9	88.6	89.4	89.5	89.6	89.5	89.5
-30	85.2	85.9	86.6	87.0	87.7	88.5	88.6	88.7	88.6	88.6
-35	84.3	85.1	85.7	86.1	86.8	87.6	87.7	87.7	87.7	87.7

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)									
	25000	27000	29000	31000	33000	35000	37000	39000	41000	43000
ENGINE ANTI-ICE ON	-0.7	-0.6	-0.6	-0.6	-0.5	-0.5	-0.5	-0.6	-0.6	-0.6
ENGINE & WING ANTI-ICE ON	-1.1	-1.1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.1	-1.2	-1.3

ALTERNATE MODE EEC

Go-Around %N1

Based on engine bleed for packs on, engine anti-ice on or off, wing anti-ice off

AIRPORT OAT		TAT (°C)	PRESSURE ALTITUDE (FT)											
			-2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
51	124	55	90.4	90.2	90.2	90.0	90.2	90.3	90.5	90.7	90.8	91.0	91.3	91.4
46	115	50	92.1	92.1	92.0	91.8	91.8	91.7	91.7	91.9	92.1	92.4	92.7	92.9
41	106	45	94.0	94.0	94.0	93.9	93.8	93.7	93.7	93.6	93.4	93.7	94.1	94.4
36	97	40	94.7	96.2	96.0	96.0	95.9	95.7	96.0	95.8	95.8	95.7	95.4	95.7
31	88	35	94.6	97.8	97.7	97.7	97.5	97.7	97.6	97.5	97.5	97.0	96.7	96.4
26	79	30	94.1	98.1	98.6	98.7	98.4	98.5	98.3	98.2	98.1	97.5	97.0	96.6
21	70	25	93.4	98.0	98.5	98.8	98.9	98.7	98.5	98.4	98.2	97.8	97.4	96.9
16	61	20	92.6	97.3	98.1	98.8	98.8	98.9	98.8	98.6	98.5	98.0	97.5	97.1
11	52	15	91.8	96.4	97.3	98.1	98.7	98.9	98.9	98.9	98.7	98.2	97.8	97.3
7	45	10	91.0	95.6	96.4	97.3	97.9	98.6	98.8	98.8	98.8	98.5	98.0	97.5
2	36	5	90.2	94.7	95.6	96.4	97.1	97.7	98.1	98.5	98.8	98.4	98.1	97.7
-3	27	0	89.4	93.9	94.7	95.5	96.2	96.9	97.2	97.6	98.0	98.0	98.0	97.7
-13	9	-10	87.7	92.1	93.0	93.8	94.4	95.1	95.4	95.8	96.2	96.2	96.3	96.3
-23	-9	-20	86.0	90.4	91.2	92.0	92.6	93.3	93.6	94.0	94.4	94.4	94.4	94.5
-33	-27	-30	84.3	88.6	89.4	90.1	90.8	91.4	91.7	92.1	92.5	92.5	92.5	92.6
-43	-45	-40	82.6	86.7	87.5	88.3	88.9	89.5	89.8	90.2	90.6	90.6	90.6	90.7
-53	-63	-50	80.8	84.9	85.6	86.4	86.9	87.6	87.9	88.2	88.6	88.6	88.7	88.7

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)						
	-1000	0	2000	4000	6000	8000	9000
PACKS OFF	0.8	0.8	0.9	1.0	1.0	1.1	1.1
WING ANTI-ICE ON	-0.4	-0.4	-0.5	-0.5	-0.5	-0.6	-0.6

Intentionally
Blank

Performance Inflight
Alternate Mode EEC, Engine INOP

Chapter PI
Section 55

ALTERNATE MODE EEC

ENGINE INOP

Initial Max Continuous %N1

Based on .84M, engine bleed for packs on or off and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	91.4	90.5	89.8	89.3	88.9	88.2	88.4	88.8	89.2
15	92.9	91.9	91.1	90.5	90.0	89.3	89.5	89.8	90.1
10	94.1	93.2	92.3	91.7	91.1	90.4	90.6	90.8	90.9
5	93.3	94.2	93.4	92.8	92.3	91.5	91.7	91.7	91.8
0	92.4	94.1	94.6	93.9	93.3	92.5	92.7	92.7	92.7
-5	91.6	93.2	94.9	94.9	94.4	93.6	93.7	93.7	93.6
-10	90.7	92.3	94.0	95.0	95.2	94.5	94.7	94.6	94.5
-15	89.9	91.5	93.1	94.0	95.0	95.0	95.1	95.0	95.0
-20	89.0	90.6	92.2	93.1	94.0	94.1	94.1	94.1	94.0
-25	88.1	89.7	91.3	92.2	93.1	93.2	93.2	93.2	93.1
-30	87.2	88.8	90.4	91.3	92.2	92.2	92.3	92.2	92.2
-35	86.3	87.8	89.5	90.3	91.2	91.3	91.3	91.3	91.2
-40	85.4	86.9	88.5	89.4	90.2	90.3	90.3	90.3	90.3

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
ENGINE ONLY	-0.7	-0.9	-0.8	-0.7	-0.6	-0.6	-0.6	-0.7	-0.7
ENGINE & WING*	-1.2	-1.4	-1.4	-1.2	-1.2	-1.2	-1.2	-1.4	-1.4
ENGINE & WING**	-1.7	-1.9	-1.9	-1.8	-1.7	-1.8	-1.9	-2.1	-2.2

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

ALTERNATE MODE EEC

ENGINE INOP

Max Continuous %N1

Based on engine bleed for packs on or off and anti-ice off

320 KIAS

TAT (°C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	92.3	93.5	94.8	93.0	91.7	90.6	89.3									
25	91.5	95.2	96.6	94.7	93.3	92.3	90.2	90.0	89.5	89.1						
20	90.8	95.0	98.1	96.6	95.0	93.9	91.6	91.4	91.0	90.7	90.6	90.2				
15	90.0	94.2	97.3	96.9	96.8	95.7	93.1	93.1	92.8	92.5	92.2	91.7	91.3	91.3	91.6	92.0
10	89.2	93.4	96.5	96.0	96.0	96.1	94.8	94.2	94.2	94.4	93.6	93.0	92.5	92.2	92.5	92.9
5	88.4	92.6	95.6	95.2	95.1	95.3	93.9	94.0	93.8	93.7	94.7	94.1	93.5	93.1	93.4	93.7
0	87.6	91.7	94.7	94.3	94.2	94.4	93.1	93.2	93.0	92.8	93.8	94.6	94.6	93.9	94.3	94.6
-5	86.8	90.9	93.9	93.5	93.4	93.6	92.2	92.3	92.1	92.0	92.9	93.7	94.5	94.4	94.9	95.1
-10	86.0	90.0	93.0	92.6	92.5	92.7	91.4	91.5	91.3	91.1	92.1	92.8	93.6	93.5	94.1	94.2
-15	85.2	89.2	92.1	91.7	91.6	91.8	90.5	90.6	90.4	90.2	91.2	91.9	92.7	92.6	93.2	93.3
-20	84.3	88.3	91.2	90.8	90.7	90.9	89.6	89.7	89.5	89.4	90.3	91.0	91.8	91.7	92.3	92.4
-25	83.5	87.4	90.3	89.9	89.8	90.0	88.7	88.8	88.6	88.5	89.4	90.1	90.9	90.8	91.4	91.4
-30	82.7	86.6	89.4	89.0	88.9	89.1	87.8	87.9	87.7	87.6	88.5	89.2	89.9	89.9	90.5	90.5
-35	81.8	85.7	88.5	88.1	88.0	88.2	86.9	87.0	86.8	86.7	87.6	88.3	89.0	88.9	89.5	89.6
-40	80.9	84.8	87.5	87.1	87.1	87.2	86.0	86.1	85.9	85.7	86.7	87.4	88.1	88.0	88.6	88.6

280 KIAS

TAT (°C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	91.2	91.9	93.0	91.3	90.5	89.7	89.8									
25	91.3	93.6	94.7	92.9	91.9	90.9	90.6	90.0	89.6	89.3						
20	90.5	95.5	96.8	94.9	93.5	92.4	91.6	90.9	90.3	90.0	89.2	88.4				
15	89.7	95.0	98.2	97.0	95.5	94.2	92.6	92.0	91.4	91.2	90.5	89.7	89.7	90.4	90.0	89.5
10	88.9	94.2	97.3	97.2	97.3	96.1	93.5	93.3	92.7	92.5	92.1	91.6	91.4	91.6	91.2	90.5
5	88.1	93.4	96.5	96.3	96.4	96.7	95.1	94.3	94.7	94.6	93.7	93.2	92.9	92.8	92.3	91.6
0	87.3	92.5	95.6	95.4	95.6	95.8	94.4	94.4	94.6	94.9	96.2	94.9	94.3	93.9	93.3	92.6
-5	86.5	91.7	94.7	94.5	94.7	94.9	93.6	93.6	93.8	94.0	95.8	96.4	95.5	94.9	94.4	93.6
-10	85.7	90.8	93.8	93.7	93.8	94.1	92.7	92.7	92.9	93.2	94.9	95.5	96.0	95.7	95.3	94.5
-15	84.9	90.0	92.9	92.8	92.9	93.2	91.8	91.8	92.0	92.3	94.0	94.6	95.1	95.2	95.4	94.6
-20	84.1	89.1	92.0	91.9	92.0	92.2	90.9	90.9	91.2	91.4	93.1	93.7	94.2	94.3	94.5	93.6
-25	83.3	88.2	91.1	91.0	91.1	91.3	90.0	90.0	90.2	90.5	92.2	92.8	93.2	93.3	93.6	92.7
-30	82.4	87.3	90.2	90.0	90.2	90.4	89.1	89.1	89.3	89.5	91.3	91.8	92.3	92.4	92.6	91.8
-35	81.6	86.4	89.3	89.1	89.2	89.5	88.2	88.2	88.4	88.6	90.3	90.9	91.3	91.4	91.7	90.8
-40	80.7	85.5	88.3	88.2	88.3	88.5	87.2	87.2	87.5	87.7	89.4	89.9	90.4	90.5	90.7	89.9

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	-0.6	-0.5	-0.5	-0.4	-0.4	-0.5	-0.6	-0.7	-0.8	-0.8	-0.7	-0.9	-0.8	-0.7	-0.6	-0.6
ENGINE & WING*	-0.9	-0.9	-0.9	-0.8	-0.8	-0.9	-1.1	-1.2	-1.3	-1.3	-1.2	-1.4	-1.4	-1.2	-1.2	-1.2
ENGINE & WING**	-1.2	-1.2	-1.2	-1.2	-1.2	-1.4	-1.5	-1.7	-1.9	-1.9	-1.7	-1.9	-1.9	-1.8	-1.7	-1.8

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

ALTERNATE MODE EEC

ENGINE INOP

Max Continuous %N1

Based on engine bleed for packs on or off and anti-ice off

240 KIAS

TAT (°C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	90.5	90.6	91.4	89.3	89.1	89.0	89.1									
25	90.5	91.6	92.8	90.6	90.2	89.8	90.0	89.6	89.3	89.4						
20	89.8	92.4	94.1	92.1	91.5	90.7	90.8	90.5	90.2	90.1	89.2	88.0				
15	89.1	92.9	95.3	94.0	93.3	92.2	91.8	91.4	91.0	90.9	90.2	88.8	87.1	86.0	86.5	88.0
10	88.3	92.1	95.5	95.9	95.2	94.0	92.9	92.5	92.0	91.8	91.0	89.9	88.6	87.5	86.9	88.2
5	87.5	91.3	94.6	95.5	96.5	95.9	94.1	93.7	93.2	93.0	92.0	91.1	90.1	89.2	88.8	89.7
0	86.7	90.4	93.8	94.6	95.6	96.2	94.7	94.4	94.5	94.3	93.1	92.3	91.8	90.9	90.5	91.0
-5	85.9	89.6	92.9	93.7	94.7	95.3	93.9	94.2	94.3	94.4	94.2	93.5	93.4	92.5	91.8	92.1
-10	85.1	88.8	92.1	92.9	93.8	94.4	93.0	93.4	93.5	93.6	94.1	94.5	94.4	93.8	93.2	93.3
-15	84.3	87.9	91.2	92.0	92.9	93.5	92.1	92.5	92.6	92.7	93.2	94.2	95.0	94.7	94.1	94.1
-20	83.5	87.1	90.3	91.1	92.0	92.6	91.2	91.6	91.7	91.8	92.3	93.2	94.4	94.8	94.7	94.7
-25	82.7	86.2	89.4	90.2	91.1	91.7	90.3	90.7	90.8	90.9	91.3	92.3	93.4	93.8	94.0	94.1
-30	81.8	85.3	88.5	89.3	90.2	90.8	89.4	89.7	89.9	89.9	90.4	91.4	92.5	92.9	93.0	93.1
-35	81.0	84.4	87.6	88.3	89.3	89.8	88.5	88.8	89.0	89.0	89.5	90.4	91.5	91.9	92.1	92.2
-40	80.1	83.6	86.6	87.4	88.3	88.9	87.6	87.9	88.0	88.1	88.5	89.5	90.6	91.0	91.1	91.2

200 KIAS

TAT (°C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	89.8	89.6	89.9	88.2	88.3	88.3	89.4									
25	90.1	90.8	91.6	88.9	89.1	89.1	89.2	89.3	89.9	90.2						
20	90.1	91.4	92.6	89.6	89.9	89.9	90.0	89.6	89.2	89.4	89.5	89.5				
15	89.4	91.4	92.8	90.6	91.0	90.9	90.9	90.5	90.1	89.9	89.0	88.7	88.7	89.2	89.7	88.8
10	88.6	91.0	92.8	91.7	92.2	92.2	91.6	91.0	90.8	89.9	89.0	88.0	88.4	88.9	88.0	
5	87.8	90.2	92.1	92.5	93.0	93.7	93.4	92.8	92.2	91.9	90.8	89.9	89.0	88.4	88.1	87.2
0	87.0	89.4	91.3	91.7	92.8	93.8	94.7	94.1	93.5	93.2	91.9	90.9	90.0	89.2	88.7	88.0
-5	86.2	88.6	90.4	90.8	91.9	93.1	94.2	94.5	94.7	94.5	93.1	91.9	90.9	90.0	89.4	89.1
-10	85.4	87.7	89.6	90.0	91.1	92.3	93.3	93.9	94.3	94.6	94.1	92.8	91.8	90.8	90.1	90.0
-15	84.6	86.9	88.7	89.1	90.2	91.4	92.4	93.0	93.5	93.7	93.9	93.4	92.4	91.5	90.7	90.8
-20	83.8	86.0	87.9	88.2	89.3	90.5	91.5	92.1	92.6	92.8	93.0	93.0	92.7	91.7	91.1	91.4
-25	82.9	85.2	87.0	87.4	88.4	89.6	90.6	91.1	91.6	91.9	92.1	92.1	92.2	91.8	91.1	91.6
-30	82.1	84.3	86.1	86.5	87.5	88.7	89.7	90.2	90.7	91.0	91.2	91.2	91.2	90.8	90.7	91.3
-35	81.2	83.5	85.2	85.6	86.6	87.8	88.8	89.3	89.8	90.0	90.2	90.2	90.3	89.9	89.7	90.4
-40	80.4	82.6	84.3	84.7	85.7	86.8	87.8	88.3	88.8	89.1	89.3	89.3	89.3	89.0	88.8	89.4

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	-0.6	-0.5	-0.5	-0.4	-0.4	-0.5	-0.6	-0.7	-0.8	-0.8	-0.7	-0.9	-0.8	-0.7	-0.6	-0.6
ENGINE & WING*	-0.9	-0.9	-0.9	-0.8	-0.8	-0.9	-1.1	-1.2	-1.3	-1.3	-1.2	-1.4	-1.4	-1.2	-1.2	-1.2
ENGINE & WING**	-1.2	-1.2	-1.2	-1.2	-1.2	-1.4	-1.5	-1.7	-1.9	-1.9	-1.7	-1.9	-1.9	-1.8	-1.7	-1.8

*Wing anti-ice on, packs on.

**Wing anti-ice on, packs off.

Intentionally
Blank

Performance Inflight

Gear Down

Chapter PI

Section 56

GEAR DOWN

220 KIAS Max Climb EPR

TAT (°C)	PRESSURE ALTITUDE (1000 FT)															
	0	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35
55	1.204	1.203	1.223	1.231	1.241	1.252	1.262	1.276	1.279	1.281	1.282	1.274	1.265	1.252	1.238	1.219
50	1.221	1.215	1.223	1.231	1.241	1.252	1.262	1.276	1.279	1.281	1.282	1.274	1.265	1.252	1.238	1.219
45	1.239	1.232	1.223	1.231	1.241	1.252	1.262	1.276	1.279	1.281	1.282	1.274	1.265	1.252	1.238	1.219
40	1.258	1.250	1.242	1.239	1.241	1.252	1.262	1.276	1.279	1.281	1.282	1.274	1.265	1.252	1.238	1.219
35	1.271	1.270	1.260	1.260	1.257	1.252	1.262	1.276	1.279	1.281	1.282	1.274	1.265	1.252	1.238	1.219
30	1.271	1.293	1.284	1.283	1.282	1.278	1.273	1.276	1.279	1.281	1.282	1.274	1.265	1.252	1.238	1.219
25	1.271	1.303	1.311	1.309	1.307	1.304	1.301	1.299	1.284	1.281	1.282	1.274	1.265	1.252	1.238	1.219
20	1.271	1.303	1.339	1.337	1.335	1.334	1.331	1.329	1.316	1.300	1.291	1.274	1.265	1.252	1.238	1.219
15	1.271	1.303	1.343	1.361	1.367	1.368	1.365	1.363	1.348	1.333	1.325	1.299	1.271	1.252	1.238	1.219
10	1.271	1.303	1.343	1.361	1.385	1.404	1.403	1.402	1.386	1.369	1.360	1.334	1.308	1.277	1.243	1.219
5	1.271	1.303	1.343	1.361	1.385	1.410	1.435	1.444	1.429	1.410	1.400	1.372	1.345	1.317	1.288	1.253
0	1.271	1.303	1.343	1.361	1.385	1.410	1.435	1.464	1.471	1.455	1.447	1.413	1.385	1.359	1.332	1.306
-5	1.271	1.303	1.343	1.361	1.385	1.410	1.435	1.464	1.475	1.486	1.492	1.456	1.426	1.402	1.380	1.359
-10	1.271	1.303	1.343	1.361	1.385	1.410	1.435	1.464	1.475	1.486	1.492	1.494	1.464	1.441	1.426	1.407
-15	1.271	1.303	1.343	1.361	1.385	1.410	1.435	1.464	1.475	1.486	1.492	1.494	1.495	1.475	1.463	1.450
-20	1.271	1.303	1.343	1.361	1.385	1.410	1.435	1.464	1.475	1.486	1.492	1.494	1.495	1.499	1.493	1.484

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)							
	0	5	10	15	20	25	30	35
ENGINE ONLY	-.016	-.015	-.015	-.009	-.017	-.023	-.019	-.016
ENGINE AND WING*	-.022	-.023	-.025	-.020	-.030	-.038	-.034	-.032
ENGINE AND WING**	-.029	-.031	-.035	-.030	-.043	-.053	-.048	-.048

*Wing anti-ice on, dual bleed source and packs on or off.

**Wing anti-ice on, single bleed source and both packs off.

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
660	14400	14300	12000
640	15800	15700	13600
620	17100	17000	15100
600	18400	18300	16500
580	19700	19600	17900
560	20800	20700	19300
540	21900	21800	20500
520	23000	22900	21700
500	24200	24100	22800
480	25300	25200	24000
460	26300	26100	25100
440	27300	27100	26200
420	28300	28000	27200
400	29400	29100	28300
380	30600	30100	29400
360	31500	31200	30600
340	32200	31900	31500

GEAR DOWN

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)										
		10	13	15	17	19	21	23	25	27	29	31
660	EPR	1.204	1.253	1.291								
	MACH	.479	.499	.511								
	KIAS	265	261	258								
	FF/ENG	15529	15395	15416								
620	EPR	1.186	1.228	1.261	1.301							
	MACH	.469	.489	.501	.514							
	KIAS	259	256	252	249							
	FF/ENG	14589	14433	14371	14499							
580	EPR	1.167	1.205	1.234	1.266	1.312						
	MACH	.457	.478	.491	.504	.517						
	KIAS	253	250	247	244	241						
	FF/ENG	13649	13497	13400	13407	13541						
540	EPR	1.150	1.183	1.208	1.236	1.272	1.322					
	MACH	.444	.465	.479	.492	.505	.519					
	KIAS	245	243	241	238	235	232					
	FF/ENG	12713	12572	12457	12394	12420	12552					
500	EPR	1.132	1.162	1.184	1.208	1.239	1.277	1.336				
	MACH	.430	.452	.466	.480	.493	.507	.527				
	KIAS	238	236	234	232	229	226	226				
	FF/ENG	11769	11644	11535	11422	11399	11426	11779				
460	EPR	1.115	1.141	1.160	1.182	1.209	1.241	1.285	1.347			
	MACH	.415	.436	.451	.465	.480	.493	.513	.534			
	KIAS	229	228	226	225	223	220	220	220			
	FF/ENG	10894	10707	10614	10495	10443	10413	10634	10992			
420	EPR	1.099	1.121	1.138	1.157	1.178	1.208	1.246	1.291	1.357		
	MACH	.398	.420	.434	.449	.464	.478	.498	.519	.540		
	KIAS	220	219	218	217	215	213	213	213	213		
	FF/ENG	10010	9791	9683	9581	9527	9501	9605	9792	10171		
380	EPR	1.083	1.103	1.117	1.132	1.149	1.177	1.212	1.247	1.294	1.361	
	MACH	.381	.402	.416	.431	.446	.463	.482	.502	.523	.546	
	KIAS	210	209	209	208	207	206	206	206	206	206	
	FF/ENG	9133	8911	8771	8660	8625	8650	8724	8803	8956	9326	
340	EPR	1.070	1.086	1.098	1.110	1.121	1.147	1.180	1.209	1.245	1.293	1.360
	MACH	.362	.382	.397	.412	.429	.446	.465	.484	.505	.527	.549
	KIAS	199	199	199	199	199	199	199	199	199	199	199
	FF/ENG	8341	8164	8039	7946	7798	7838	7883	7931	7997	8134	8478

GEAR DOWN

**Long Range Cruise Enroute Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
315	285	258	236	217	200	190	180	171	162	154
634	570	515	471	433	400	378	359	340	324	309
955	858	774	706	650	600	567	537	509	485	463
1280	1149	1035	943	867	800	756	715	679	646	617
1609	1441	1297	1180	1084	1000	944	894	848	807	771
1940	1736	1560	1419	1302	1200	1133	1072	1017	968	924
2276	2034	1825	1658	1520	1400	1322	1251	1186	1128	1077
2615	2334	2091	1898	1739	1600	1510	1429	1354	1288	1229
2959	2636	2359	2139	1958	1800	1699	1606	1523	1448	1382
3307	2942	2629	2381	2177	2000	1887	1784	1691	1607	1534
3660	3251	2901	2623	2397	2200	2075	1961	1859	1767	1685
4017	3563	3174	2867	2617	2400	2263	2139	2026	1925	1837
4378	3877	3449	3112	2838	2600	2451	2316	2193	2084	1987
4743	4194	3725	3357	3059	2800	2639	2493	2360	2242	2138
5112	4514	4003	3603	3280	3000	2827	2669	2527	2400	2288
5485	4835	4282	3850	3502	3200	3014	2845	2693	2557	2437
5862	5160	4563	4098	3724	3400	3202	3021	2858	2714	2587
6245	5488	4845	4346	3946	3600	3389	3197	3024	2870	2735
6632	5819	5129	4596	4169	3800	3577	3373	3190	3027	2884
7023	6152	5415	4846	4392	4000	3764	3549	3356	3183	3032

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)							
	10		14		20		24	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	17.0	0:45	15.5	0:44	13.7	0:42	13.4	0:40
400	33.1	1:31	30.5	1:27	27.5	1:23	26.8	1:19
600	49.2	2:18	45.5	2:11	41.2	2:03	40.2	1:57
800	65.3	3:04	60.5	2:55	55.0	2:44	53.6	2:35
1000	81.4	3:50	75.5	3:38	68.7	3:24	67.0	3:13
1200	96.8	4:39	89.7	4:24	81.8	4:06	79.6	3:53
1400	112.2	5:27	104.0	5:09	94.9	4:48	92.2	4:32
1600	127.2	6:16	117.9	5:55	107.7	5:30	104.5	5:12
1800	142.0	7:07	131.6	6:43	120.1	6:13	116.4	5:52
2000	156.7	7:57	145.2	7:30	132.6	6:56	128.4	6:32
2200	170.9	8:50	158.4	8:19	144.5	7:40	139.8	7:13
2400	185.1	9:43	171.6	9:08	156.4	8:24	151.2	7:55
2600	198.9	10:37	184.5	9:58	168.1	9:09	162.3	8:36
2800	212.5	11:32	197.3	10:49	179.6	9:54	173.2	9:19
3000	226.0	12:27	210.0	11:40	191.1	10:40	184.0	10:01
3200	238.9	13:23	222.1	12:32	202.2	11:27	194.4	10:44
3400	251.8	14:20	234.3	13:25	213.3	12:13	204.8	11:28
3600	264.5	15:18	246.2	14:18	224.2	13:01	214.9	12:12
3800	276.8	16:17	257.9	15:12	234.9	13:49	224.8	12:56
4000	289.2	17:16	269.6	16:06	245.5	14:37	234.7	13:41

GEAR DOWN

**Long Range Cruise Enroute Fuel and Time
Fuel Required Adjustment (1000 LB)**

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)									
	300	350	400	450	500	550	600	650	700	
20	-3.7	-2.9	-2.0	-1.1	0.0	2.6	5.2	8.0	10.9	
40	-7.8	-5.9	-4.0	-2.0	0.0	5.4	11.1	17.1	23.5	
60	-11.9	-8.9	-5.9	-3.0	0.0	8.0	16.5	25.6	35.2	
80	-16.1	-12.0	-7.9	-4.0	0.0	10.4	21.5	33.4	46.1	
100	-20.2	-15.0	-9.9	-5.0	0.0	12.6	26.2	40.7	56.1	
120	-24.4	-18.1	-12.0	-6.1	0.0	14.6	30.4	47.2	65.2	
140	-28.5	-21.2	-14.0	-7.1	0.0	16.5	34.2	53.2	73.5	
160	-32.7	-24.3	-16.1	-8.1	0.0	18.1	37.6	58.6	81.0	
180	-36.9	-27.4	-18.1	-9.1	0.0	19.5	40.6	63.3	87.6	
200	-41.0	-30.6	-20.2	-10.2	0.0	20.7	43.2	67.4	93.4	
220	-45.2	-33.7	-22.3	-11.2	0.0	21.8	45.4	70.9	98.3	
240	-49.4	-36.9	-24.5	-12.3	0.0	22.6	47.2	73.8	102.3	
260	-53.6	-40.1	-26.6	-13.3	0.0	23.2	48.6	76.0	105.5	
280	-57.9	-43.3	-28.8	-14.4	0.0	23.7	49.5	77.6	107.9	
300	-62.1	-46.5	-31.0	-15.5	0.0	23.9	50.1	78.6	109.4	

Descent at VREF30+80

PRESSURE ALT (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	54	58	63	67	71	75	79	84	88	92
TIME (MINUTES)	13	14	15	16	16	17	17	18	19	19

GEAR DOWN

**Holding
Flaps Up**

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
660	EPR	1.111	1.139	1.194	1.281			
	KIAS	249	249	249	249			
	FF/ENG	15280	15000	15140	15520			
620	EPR	1.100	1.125	1.174	1.250			
	KIAS	242	242	242	242			
	FF/ENG	14400	14090	14160	14360			
580	EPR	1.090	1.113	1.157	1.223	1.339		
	KIAS	237	237	237	237	237		
	FF/ENG	13620	13290	13290	13370	14160		
540	EPR	1.081	1.101	1.140	1.199	1.292		
	KIAS	232	232	232	232	232		
	FF/ENG	12860	12580	12460	12470	12970		
500	EPR	1.072	1.090	1.125	1.175	1.255		
	KIAS	226	226	226	226	226		
	FF/ENG	12060	11860	11680	11600	11850		
460	EPR	1.063	1.079	1.110	1.154	1.222	1.347	
	KIAS	220	220	220	220	220	220	
	FF/ENG	11250	11110	10910	10750	10850	11540	
420	EPR	1.054	1.068	1.095	1.134	1.191	1.291	
	KIAS	213	213	213	213	213	213	
	FF/ENG	10450	10300	10150	9880	9920	10280	
380	EPR	1.047	1.059	1.081	1.115	1.161	1.247	1.408
	KIAS	206	206	206	206	206	206	206
	FF/ENG	9660	9490	9380	9080	9050	9240	10040
340	EPR	1.040	1.050	1.069	1.098	1.133	1.209	1.323
	KIAS	199	199	199	199	199	199	199
	FF/ENG	9020	8860	8720	8440	8210	8330	8700

This table includes 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN

**Holding
Flaps 1**

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
660	EPR	1.115	1.143	1.198	1.284	
	KIAS	229	229	229	229	
	FF/ENG	14670	14390	14570	14830	
620	EPR	1.103	1.129	1.177	1.252	
	KIAS	222	222	222	222	
	FF/ENG	13770	13480	13560	13700	
580	EPR	1.093	1.115	1.159	1.223	1.332
	KIAS	217	217	217	217	217
	FF/ENG	12930	12690	12630	12720	13310
540	EPR	1.083	1.103	1.142	1.197	1.285
	KIAS	212	212	212	212	212
	FF/ENG	12130	11960	11820	11820	12130
500	EPR	1.073	1.091	1.125	1.174	1.247
	KIAS	206	206	206	206	206
	FF/ENG	11300	11160	11010	10920	11050
460	EPR	1.064	1.079	1.109	1.152	1.211
	KIAS	200	200	200	200	200
	FF/ENG	10490	10340	10230	10020	10080
420	EPR	1.054	1.068	1.094	1.131	1.177
	KIAS	193	193	193	193	193
	FF/ENG	9680	9520	9440	9150	9170
380	EPR	1.047	1.058	1.080	1.111	1.146
	KIAS	186	186	186	186	186
	FF/ENG	9010	8870	8750	8490	8310
340	EPR	1.039	1.049	1.067	1.093	1.115
	KIAS	179	179	179	179	179
	FF/ENG	8200	8080	7950	7730	7610

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight
Gear Down, Engine INOP

Chapter PI
Section 57

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 LB)		VREF30 + 80 DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
500	476	224	4100	2800	
460	438	218	6700	5900	5000
420	401	211	9300	8700	7900
380	364	204	12400	11900	11100
340	326	197	14900	14000	13200

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
500			
480	2100		
460	4000	2400	
440	5800	4800	3200
420	7500	6700	5800
400	9200	8500	7700
380	11200	10300	9500
360	12700	12200	11500
340	13900	13200	12600

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)					
		5	7	9	11	13	15
480	EPR						
	MACH						
	KIAS						
	FF/ENG						
440	EPR	1.312	1.361				
	MACH	.366	.379				
	KIAS	221	221				
	FF/ENG	20938	21487				
400	EPR	1.263	1.302	1.351	1.409		
	MACH	.349	.362	.375	.389		
	KIAS	211	211	211	210		
	FF/ENG	18577	18792	19254	19826		
360	EPR	1.227	1.257	1.294	1.342	1.403	
	MACH	.335	.347	.360	.374	.389	
	KIAS	202	203	203	203	203	
	FF/ENG	16667	16770	16958	17332	17890	
340	EPR	1.212	1.239	1.271	1.313	1.366	1.439
	MACH	.329	.341	.354	.367	.382	.397
	KIAS	199	199	199	199	199	199
	FF/ENG	15842	15909	16058	16265	16688	17379

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
353	309	271	242	220	200	186	174	163	153	145
533	465	408	364	330	300	279	260	244	229	217
714	622	545	486	440	400	372	347	324	305	288
897	781	684	609	550	500	464	433	404	380	360
1080	940	822	732	661	600	557	518	485	456	431
1265	1100	961	855	772	700	650	604	565	531	502
1450	1260	1100	978	882	800	742	690	645	606	573
1637	1420	1239	1101	993	900	835	777	725	681	643
1824	1582	1378	1224	1104	1000	927	863	805	756	714
2013	1744	1518	1348	1214	1100	1020	949	886	831	785
2202	1907	1659	1472	1325	1200	1113	1035	966	906	856

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)							
	6		8		10		12	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	15.9	0:55	15.5	0:54	15.2	0:53	15.0	0:51
300	23.9	1:22	23.3	1:20	22.9	1:18	22.7	1:16
400	31.8	1:49	31.1	1:46	30.7	1:43	30.4	1:40
500	39.4	2:16	38.5	2:12	38.0	2:09	37.8	2:05
600	47.1	2:43	46.0	2:39	45.4	2:34	45.1	2:30
700	54.7	3:11	53.5	3:05	52.8	3:00	52.5	2:55
800	62.4	3:38	61.0	3:32	60.1	3:26	59.8	3:20
900	69.7	4:06	68.2	3:59	67.2	3:52	66.8	3:46
1000	77.1	4:34	75.5	4:26	74.3	4:18	73.7	4:11
1100	84.3	5:02	82.5	4:54	81.2	4:45	80.5	4:37
1200	91.5	5:31	89.5	5:21	88.1	5:12	87.3	5:03

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)						
	300	350	400	450	500	550	
10	-1.4	-0.7	0.0	1.3	2.3	3.4	
20	-2.8	-1.5	0.0	2.9	5.5	7.8	
30	-4.3	-2.2	0.0	4.5	8.6	12.2	
40	-5.7	-2.9	0.0	5.9	11.6	16.5	
50	-7.1	-3.7	0.0	7.3	14.4	20.8	
60	-8.5	-4.4	0.0	8.7	17.2	25.0	
70	-9.8	-5.1	0.0	9.9	19.9	29.2	
80	-11.2	-5.8	0.0	11.0	22.6	33.3	
90	-12.5	-6.5	0.0	12.1	25.1	37.4	
100	-13.8	-7.2	0.0	13.1	27.5	41.4	

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)			
		1500	5000	10000	15000
500	EPR	1.286			
	KIAS	226			
	FF/ENG	23810			
460	EPR	1.255	1.320		
	KIAS	220	220		
	FF/ENG	22000	22290		
420	EPR	1.227	1.278		
	KIAS	213	213		
	FF/ENG	20230	20240		
380	EPR	1.200	1.243	1.345	
	KIAS	206	206	206	
	FF/ENG	18490	18390	19110	
340	EPR	1.175	1.212	1.291	1.439
	KIAS	199	199	199	199
	FF/ENG	16750	16630	16950	18250

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight Text

Chapter PI Section 58

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer. In addition, sufficient inflight data is provided to complete a flight with the FMC inoperative. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General

FMC Takeoff Speeds

FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Clearway and Stopway V1 Adjustments

Takeoff speed corrections are to be applied to V1 when using takeoff weights based on the use of clearway and stopway.

Adjust V1 by the amount shown in the table. The adjusted V1 must not exceed VR. If V1 is greater than VR, VR may be increased to equal V1. The resultant V2 will be increased by the same amount that VR was increased.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF Speeds

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver speeds. Using VREF as the basis for the schedule makes it variable as a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assume an engine failure at the critical point during the takeoff.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush depths greater than 13mm (0.5 inches) are not recommended because of possible airplane damage as a result of slush impingement on the airplane structure. The use of assumed temperature for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight is determined as follows:

- (1) Determine the dry field/obstacle limit weight for the takeoff flap setting.
- (2) Enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.
- (3) Adjust field length available for temperature by amount shown on chart.

(4) Enter the V1(MCG) Limit Weight table with the field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

(1) Determine takeoff speeds V1, VR and V2 for actual brake release weight using Takeoff Speeds from the Performance Dispatch chapter or from the FMC.

(2) If V1(MCG) limited, set $V1 = V1(MCG)$. If not limited by V1(MCG) considerations, enter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than V1(MCG), set $V1 = V1(MCG)$.

Slippery Runway

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on reversers operating and a 15 ft screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Go-Around EPR

To find Go-Around EPR based on normal engine bleed for packs on and anti-ice off, enter the Go-Around EPR table with airport pressure altitude and reported OAT or TAT and read EPR. EPR adjustments are shown for engine bleeds for various conditions.

Max Climb EPR

This table shows Max Climb EPR for a 310/.84 climb speed schedule, normal engine bleed for packs on and anti-ice off. Enter the table with airport pressure altitude and TAT and read EPR. EPR adjustments are shown for anti-ice operation.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Body attitude and average EPR information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome may also cause unreliable airspeed/Mach indications. Climb, cruise and descent information is based on the recommended turbulent air penetration speed schedule: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and above; maintain a minimum speed of 15 knots above the minimum maneuvering speed when below 0.82 Mach. This schedule provides ample protection from stall and high speed buffet, while also providing protection from exceeding structural limits.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Control

These tables provide target EPR, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude, .84 Mach approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .84/310/250 descent. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent at .84/310/250

Distance and time for descent are shown for a .84/310/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing Flaps 30 at the outer marker.

Holding

Target EPR, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the FMC optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed for the selected flap setting. Flaps 1 is based on VREF30+60 speed schedule. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read EPR, IAS and fuel flow per engine.

Advisory Information

Normal Configuration Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and slippery runways with good, medium, and poor reported braking action. These values are actual landing distances and do not include the 1.67 regulatory factor. Therefore, they cannot be used to determine the dispatch required landing field length.

To use these tables, determine the reference landing distance for the selected braking configuration. Then adjust the reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers to obtain the actual landing distance.

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. If the surface is affected by water, snow, or ice, and the braking action is reported as "good", conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate "poor" data reflects runways covered with wet ice.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" braking action, the airplane may not be able to achieve these deceleration rates. In these cases, runway slope and inoperative reversers influence the stopping distance. Since it cannot be determined quickly when this becomes a factor, it is appropriate to add the effects of slope and inoperative reversers when using the autobrake system.

Non-Normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances and adjustments are provided for dry runways and runways with good, medium, and poor reported braking action.

Enter the table with the applicable non-normal configuration and read the normal approach speed. The reference landing distance is a reference distance from 50 ft above the threshold to stop based on a reference landing weight and speed at sea level, zero wind, and zero slope. Subsequent columns provide corrections for off-reference landing weight, altitude, wind, slope, and speed conditions. Each corrections is independently added to the reference landing distance. Landing distance includes the effects of max manual braking and reverse thrust.

For an engine inoperative autoland, check the rate of climb capability shown in Gear Down Landing Rate of Climb Available tables to ensure adequate climb performance.

Landing Climb Limit Weight

In the event an overweight landing is necessary and the fuel dump system is unavailable, landing climb limits should be checked if a Flaps 30 landing is planned. Enter the table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required. At weights exceeding those shown, plan a Flaps 20 landing.

Recommended Brake Cooling Schedule

Advisory information is provided to assist in avoiding problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Recommended Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind, at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the appropriate Event Adjusted Brake Energy Table (No Reverse Thrust or 2 Engine Reverse) with the reference brake energy per brake and the type of

braking used during landing (Max Manual, Max Auto, or Autobrake). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing. The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Brake Temperature Monitor System (BTMS) indications are also shown. If brake cooling is determined from the BTMS, the hottest brake indication 10 to 15 minutes after the airplane has come to a complete stop, or inflight with gear retracted, may be used to determine recommended cooling schedule by entering at the bottom of the chart. An EICAS advisory message, BRAKE TEMP, will appear when any brake registers 5.0 or higher on the EICAS indication and disappear as the hottest brake cools with an EICAS indication of 3.5. Note that even without an EICAS advisory message, brake cooling is recommended.

Engine Inoperative

Initial Max Continuous EPR

The Initial Max Continuous EPR setting for use following an engine failure is shown. The table is based on the typical all engine cruise Mach number of .84 to provide a target EPR setting at the start of driftdown. Once driftdown is established, the Max Continuous EPR table should be used to determine EPR for the given conditions.

Max Continuous EPR

Power setting is based on one engine operating with one bleed source for pack(s) operating and all anti-ice bleeds off. Enter the table for appropriate pressure altitude with IAS or Mach and TAT to read Max Continuous EPR. Apply the anti-ice corrections below the table as required.

It is desirable to maintain engine thrust level within the limits of the Max Cruise thrust rating. However, where thrust level in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/Cruise Range Capability

This table shows the range capability from the start of driftdown.

Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to long range cruise speed. Cruise is continued at level off altitude and long range cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and correct for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required. If altitudes other than the level off altitude is used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

Table show the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on LRC speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target EPR, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (LB/HR)				
	GROSS WEIGHT (1000 LB)				
	700	600	500	400	300
43				360	310
39			420	360	310
35		470	420	380	300
31	520	500	450	370	310
25	510	490	440	380	340
20	520	520	460	410	360
15	520	520	480	440	400
10	540	520	510	490	440
5	590	590	570	530	480

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on single engine Long Range Cruise speed and .84/310/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion Table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the off reference fuel corrections table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down Landing Rate of Climb Available

Rate of climb data is provided as guidance information in the event an engine inoperative autoland is planned. The tables show gear down rate of climb available for Flaps 20 and Flaps 30. Enter the table with TAT and pressure altitude to read rate of climb available. Apply adjustments shown to correct for weight.

Alternate Mode EEC

Limit Weight

A simplified method which conservatively accounts for the effects of EEC in the ALTERNATE mode is to reduce the PRIMARY mode (normal) performance limited weights. The Limit Weight table provides takeoff field, climb, obstacle, net level off and landing climb weights. To determine limit weights for operations with the EEC in the ALTERNATE mode, enter the table with the limit weights for PRIMARY mode EEC operation and read the associated limit weight for each performance condition. The most limiting of the takeoff weights must be used. The ALTERNATE Mode EEC Landing Climb limit must be compared to the Landing Field Length limit and the more limiting of the two must be used as the landing limit weight. Analysis from the Airplane Flight Manual - Digital Performance Information may yield less restrictive limit weights.

Takeoff Speed Adjustment

Takeoff speeds for the reduced weight should be increased by the amount shown in the Takeoff Speeds Adjustments Table. The adjusted V1 should not exceed the adjusted VR.

NOTE: The FMC does incorporate ALTERNATE Mode EEC performance in its takeoff speeds calculations.

Max Takeoff %N1

Takeoff power settings are presented for normal air condition bleed. Max Takeoff %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode and maximum rated thrust is reached at a thrust lever position less than full forward. As a result, thrust overboost can occur at full forward thrust lever positions.

Max Climb %N1

This table shows Max Climb %N1 for a 310/.84 climb speed schedule with anti-ice off. Enter the table with pressure altitude and TAT to read Max Climb %N1. Apply bleed adjustments as required.

Max Cruise %N1

Maximum Cruise %N1 is presented for .84M, which approximates Long Range Cruise speed. Enter the table with pressure altitude and TAT to read Max Cruise %N1. Appropriate bleed adjustments are shown.

Go-Around %N1

Go-Around power setting for ALTERNATE MODE EEC operation is presented for normal engine bleed for packs on. Go-Around %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode and maximum rated thrust is reached at a thrust lever position less than full forward. As a result, thrust overboost can occur at full forward thrust lever positions.

Alternate Mode EEC, Engine Inoperative

Initial Max Continuous %N1

Initial Max Continuous %N1 settings for use following an engine failure are presented. The table is based on the typical all engine cruise Mach number of .84 to provide a target %N1 setting at the start of driftdown. Appropriate bleed adjustments are shown. Once driftdown is established, the Max Continuous %N1 table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Max Continuous %N1 settings are presented as a function of pressure altitude and TAT for engine inoperative speeds of 320, 280, 240, and 200 KIAS. Power settings may be interpolated for intermediate airspeeds. Apply bleed adjustments as required.

Gear Down

This section contains performance for airplane operation with the landing gear extended for all phases of flight. The data is based on engine bleeds for normal air conditioning.

Note: The Flight Management Computer System (FMCS) does not contain special provisions for operation with landing gear extended. As a result, the FMCS will generate inaccurate enroute speed schedules, display non-conservative predictions of fuel burn, estimated time of arrival (ETA), maximum altitude, and compute overly shallow descent path. To obtain accurate ETA predictions, gear down cruise speed and altitude should be entered on the CLB and CRZ pages. Gear down cruise speed should also be entered on the DES page and a STEP SIZE of zero should be entered on the PERF INIT or CRZ page. Use of VNAV during descent under these circumstances is not recommended.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

Intentionally
Blank

Performance Inflight**Chapter PI****Table of Contents****Section 60****777-300ER GE90-115BL LB FAA**

General	PI.60.1
Maximum Allowable Clearway	PI.60.1
Clearway and Stopway V1 Adjustments	PI.60.1
VREF	PI.60.2
Flap Maneuver Speed	PI.60.3
Slush/Standing Water Takeoff	PI.60.4
Slippery Runway Takeoff	PI.60.8
TO1 Slush/Standing Water Takeoff	PI.60.12
TO1 Slippery Runway Takeoff	PI.60.16
TO2 Slush/Standing Water Takeoff	PI.60.21
TO2 Slippery Runway Takeoff	PI.60.25
Minimum Control Speeds	PI.60.29
Go-Around %N1	PI.60.30
Max Climb %N1	PI.60.31
Flight With Unreliable Airspeed / Turbulent Air Penetration	PI.60.32
All Engine	PI.61.1
Long Range Cruise Maximum Operating Altitude	PI.61.1
Long Range Cruise Control	PI.61.3
Long Range Cruise Enroute Fuel and Time - Low Altitudes	PI.61.4
Long Range Cruise Enroute Fuel and Time - High Altitudes	PI.61.5
Long Range Cruise Wind-Altitude Trade	PI.61.6
Descent at .84M/310/250	PI.61.6
Holding	PI.61.7
Advisory Information	PI.62.1
Normal Configuration Landing Distance	PI.62.1
Non-Normal Configuration Landing Distance	PI.62.4
Landing Climb Limit Weight	PI.62.8
Recommended Brake Cooling Schedule	PI.62.10

Engine Inoperative	PI.63.1
Initial Max Continuous %N1	PI.63.1
Max Continuous %N1	PI.63.2
Driftdown Speed/Level Off Altitude	PI.63.5
Driftdown/LRC Cruise Range Capability	PI.63.6
Long Range Cruise Altitude Capability	PI.63.7
Long Range Cruise Control	PI.63.8
Long Range Cruise Diversion Fuel and Time	PI.63.9
Holding	PI.63.10
Gear Down Landing Rate of Climb Available	PI.63.11
 Alternate Mode EEC	 PI.64.1
Alternate Mode EEC Max Takeoff %N1	PI.64.1
 Gear Down	 PI.65.1
220 KIAS Max Climb %N1	PI.65.1
Long Range Cruise Altitude Capability	PI.65.2
Long Range Cruise Control	PI.65.3
Long Range Cruise Enroute Fuel and Time	PI.65.4
Descent at VREF30+80	PI.65.5
Holding	PI.65.6
 Gear Down, Engine Inoperative	 PI.66.1
Driftdown Speed/Level Off Altitude	PI.66.1
Long Range Cruise Altitude Capability	PI.66.1
Long Range Cruise Control	PI.66.2
Long Range Cruise Diversion Fuel and Time	PI.66.3
Holding	PI.66.5
 Text	 PI.67.1
Introduction	PI.67.1
General	PI.67.1
All Engines	PI.67.4
Advisory Information	PI.67.6
Engine Inoperative	PI.67.8

777 Flight Crew Operations Manual

Alternate Mode EEC	PI.67.11
Gear Down	PI.67.11

Intentionally
Blank

Performance Inflight
General

Chapter PI
Section 60

Maximum Allowable Clearway

FIELD LENGTH (FT)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (FT)
4000	420
6000	560
8000	680
10000	790
12000	870
14000	1000
16000	1160

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (FT)	NORMAL V1 (KIAS)														
	DRY RUNWAY					WET RUNWAY					WET SKID-RESISTANT				
	100	120	140	160	180	100	120	140	160	180	100	120	140	160	180
1000	-3	-3	-3	-3	-3										
800	-3	-3	-3	-3	-3										
600	-3	-3	-3	-2	-2										
400	-2	-2	-1	-1	-1										
200	-1	-1	0	0	0										
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-200	3	3	3	2	1	2	2	1	0	0	2	2	1	0	0
-400	5	5	4	3	2	4	3	2	1	1	4	4	2	1	1
-600	8	7	5	3	3	5	4	2	2	2	4	4	2	2	2
-800	8	8	5	3	3	6	5	3	2	2	4	4	2	2	2
-1000	8	8	5	3	3	7	7	4	3	3	4	4	2	2	2

VREF

WEIGHT (1000 LB)	FLAPS		
	30	25	20
800	185	187	200
750	180	183	196
700	173	177	189
650	162	171	183
600	156	164	176
550	149	157	168
500	142	150	161
450	135	142	152
400	127	134	144
350	118	125	134

Flap Maneuver Speed

FLAP POSITION	MANEUVER SPEED
FLAPS UP	VREF30 + 80
FLAPS 1	VREF30 + 60
FLAPS 5	VREF30 + 40
FLAPS 15	VREF30 + 20
FLAPS 20	VREF30 + 20
FLAPS 25	VREF25
FLAPS 30	VREF30

ADVISORY INFORMATION

Slush/Standing Water Takeoff

Maximum Reverse Thrust

Weight Adjustment (1000 LB)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	-83.3	-94.5	-105.7	-98.7	-109.9	-121.1	-124.4	-135.6	-146.8
800	-80.4	-91.6	-102.8	-94.8	-106.0	-117.2	-118.5	-129.7	-140.9
760	-77.3	-88.5	-99.7	-90.6	-101.8	-113.0	-112.4	-123.6	-134.8
720	-73.5	-84.7	-95.9	-85.8	-97.0	-108.2	-105.5	-116.7	-127.9
680	-69.1	-80.3	-91.5	-80.2	-91.4	-102.6	-97.9	-109.1	-120.3
640	-63.9	-75.1	-86.3	-73.8	-85.0	-96.2	-89.5	-100.7	-111.9
600	-58.1	-69.3	-80.5	-66.8	-78.0	-89.2	-80.3	-91.5	-102.7
560	-51.6	-62.8	-74.0	-59.0	-70.2	-81.4	-70.3	-81.5	-92.7
520	-44.5	-55.7	-66.9	-50.5	-61.7	-72.9	-59.6	-70.8	-82.0
480	-36.6	-47.8	-59.0	-41.3	-52.5	-63.7	-48.1	-59.3	-70.5
440	-28.1	-39.3	-50.5	-31.4	-42.6	-53.8	-35.8	-47.0	-58.2
400	-19.1	-30.3	-41.5	-20.9	-32.1	-43.3	-22.9	-34.1	-45.3
360	-10.1	-21.3	-32.5	-10.4	-21.6	-32.8	-10.1	-21.3	-32.5

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
7000	343.3			371.4			419.6		
7400	396.8			425.4			475.2	370.4	
7800	450.6	348.7		480.7	376.8		532.2	425.1	
8200	506.2	402.1		537.5	430.9		590.6	480.8	375.9
8600	563.6	456.1	354.0	596.2	486.3	382.2	650.7	537.9	430.7
9000	623.2	511.8	407.5	656.9	543.3	436.4	712.6	596.6	486.5
9400	685.1	569.5	461.6	719.8	602.2	491.9	776.3	656.8	543.7
9800	749.7	629.2	517.5	785.2	663.1	549.1		718.9	602.5
10200	817.0	691.4	575.4		726.2	608.2		782.9	662.9
10600		756.3	635.3		791.9	669.3			725.2
11000		823.8	697.8			732.7			789.4
11400			763.0			798.6			

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -180 ft/+170 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slush/Standing Water Takeoff
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-25	-23	-21	-21	-19	-17	-14	-12	-10
760	-27	-25	-23	-23	-21	-19	-15	-13	-11
720	-29	-27	-25	-25	-23	-21	-16	-14	-12
680	-30	-28	-26	-26	-24	-22	-18	-16	-14
640	-31	-29	-27	-27	-25	-23	-19	-17	-15
600	-31	-29	-27	-28	-26	-24	-20	-18	-16
560	-31	-29	-27	-28	-26	-24	-22	-20	-18
520	-31	-29	-27	-28	-26	-24	-23	-21	-19
480	-30	-28	-26	-28	-26	-24	-23	-21	-19
440	-29	-27	-25	-28	-26	-24	-24	-22	-20
400	-29	-27	-25	-27	-25	-23	-24	-22	-20
360	-28	-26	-24	-26	-24	-22	-24	-22	-20

- 1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
- 2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slush/Standing Water Takeoff

No Reverse Thrust

Weight Adjustment (1000 LB)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	-115.4	-127.8	-140.2	-134.1	-146.5	-158.9	-164.7	-177.1	-189.5
800	-110.3	-122.7	-135.1	-127.5	-139.9	-152.3	-155.2	-167.6	-180.0
760	-105.1	-117.5	-129.9	-120.8	-133.2	-145.6	-145.5	-157.9	-170.3
720	-99.3	-111.7	-124.1	-113.4	-125.8	-138.2	-135.4	-147.8	-160.2
680	-92.9	-105.3	-117.7	-105.5	-117.9	-130.3	-124.7	-137.1	-149.5
640	-85.9	-98.3	-110.7	-97.0	-109.4	-121.8	-113.5	-125.9	-138.3
600	-78.3	-90.7	-103.1	-88.0	-100.4	-112.8	-101.8	-114.2	-126.6
560	-70.1	-82.5	-94.9	-78.3	-90.7	-103.1	-89.6	-102.0	-114.4
520	-61.3	-73.7	-86.1	-68.1	-80.5	-92.9	-76.9	-89.3	-101.7
480	-51.9	-64.3	-76.7	-57.3	-69.7	-82.1	-63.7	-76.1	-88.5
440	-42.0	-54.4	-66.8	-45.9	-58.3	-70.7	-49.9	-62.3	-74.7
400	-31.6	-44.0	-56.4	-34.1	-46.5	-58.9	-35.8	-48.2	-60.6
360	-21.2	-33.6	-46.0	-22.2	-34.6	-47.0	-21.7	-34.1	-46.5

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
10200							429.6		
10600							495.1	384.7	
11000				363.8			562.5	449.1	339.8
11400				431.9	316.1		632.0	515.1	403.9
11800	363.6			502.3	384.2		703.7	583.1	468.7
12200	434.3	314.3		575.7	452.7	336.6	778.0	653.3	535.3
12600	508.2	384.8		652.8	523.9	404.6		725.7	603.9
13000	586.7	456.1	335.4	734.1	598.5	473.8		800.8	674.8
13400	670.7	531.2	405.9	820.0	676.7	545.9			748.0
13800	761.9	611.3	478.2		759.4	621.5			823.6
14200	859.2	697.2	554.7		846.1	701.0			
14600		790.9	636.4			785.2			
15000			724.4						

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -280 ft/+270 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-41	-37	-33	-35	-31	-27	-23	-19	-15
760	-43	-39	-35	-37	-33	-29	-25	-21	-17
720	-45	-41	-37	-39	-35	-31	-27	-23	-19
680	-46	-42	-38	-41	-37	-33	-29	-25	-21
640	-47	-43	-39	-42	-38	-34	-32	-28	-24
600	-47	-43	-39	-43	-39	-35	-34	-30	-26
560	-47	-43	-39	-44	-40	-36	-36	-32	-28
520	-47	-43	-39	-44	-40	-36	-37	-33	-29
480	-47	-43	-39	-44	-40	-36	-39	-35	-31
440	-46	-42	-38	-44	-40	-36	-40	-36	-32
400	-46	-42	-38	-44	-40	-36	-40	-36	-32
360	-45	-41	-37	-44	-40	-36	-41	-37	-33

- 1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
- 2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
Weight Adjustment (1000 LB)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	0.0	-3.2	-6.4	-45.4	-48.6	-51.8	-85.6	-88.8	-92.0
800	0.0	-3.2	-6.4	-46.4	-49.6	-52.8	-83.4	-86.6	-89.8
760	-2.4	-5.6	-8.8	-47.3	-50.5	-53.7	-81.1	-84.3	-87.5
720	-7.6	-10.8	-14.0	-47.7	-50.9	-54.1	-78.5	-81.7	-84.9
680	-11.3	-14.5	-17.7	-47.6	-50.8	-54.0	-75.7	-78.9	-82.1
640	-13.2	-16.4	-19.6	-47.0	-50.2	-53.4	-72.5	-75.7	-78.9
600	-13.9	-17.1	-20.3	-45.2	-48.4	-51.6	-68.3	-71.5	-74.7
560	-13.6	-16.8	-20.0	-42.2	-45.4	-48.6	-62.7	-65.9	-69.1
520	-12.4	-15.6	-18.8	-37.9	-41.1	-44.3	-55.7	-58.9	-62.1
480	-10.3	-13.5	-16.7	-32.1	-35.3	-38.5	-47.3	-50.5	-53.7
440	-7.2	-10.4	-13.6	-25.1	-28.3	-31.5	-37.5	-40.7	-43.9
400	-3.2	-6.4	-9.6	-16.8	-20.0	-23.2	-26.3	-29.5	-32.7
360	0.0	-1.4	-4.6	-7.1	-10.3	-13.5	-13.7	-16.9	-20.1

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5000	396.3								
5400	513.2	396.3							
5800	629.1	513.2	396.3						
6200	744.1	629.1	513.2	317.2					
6600	858.4	744.1	629.1	391.6					
7000		858.4	744.1	468.4	361.7				
7400			858.4	548.5	437.4	332.1			
7800				632.2	516.0	406.8			
8200				720.2	598.3	484.2	369.2		
8600				812.9	684.4	564.9	414.9		
9000					775.2	649.4	462.2	360.3	
9400						738.3	511.2	405.7	
9800						831.7	562.3	452.6	351.4
10200							615.7	501.3	396.4
10600							671.7	551.9	443.0
11000							730.6	604.8	491.4
11400							793.3	660.2	541.6
11800								718.6	594.0
12200								780.4	648.9
12600									706.6
13000									767.8

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -90 ft/+90 ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -130 ft/+120 ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -190 ft/+180 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION**Slippery Runway Takeoff****Maximum Reverse Thrust****V1 Adjustment (KIAS)**

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-7	-5	-3	-18	-16	-14	-32	-30	-28
760	-9	-7	-5	-21	-19	-17	-35	-33	-31
720	-10	-8	-6	-23	-21	-19	-37	-35	-33
680	-11	-9	-7	-24	-22	-20	-39	-37	-35
640	-12	-10	-8	-25	-23	-21	-40	-38	-36
600	-13	-11	-9	-26	-24	-22	-41	-39	-37
560	-13	-11	-9	-26	-24	-22	-41	-39	-37
520	-13	-11	-9	-27	-25	-23	-42	-40	-38
480	-14	-12	-10	-27	-25	-23	-42	-40	-38
440	-14	-12	-10	-27	-25	-23	-42	-40	-38
400	-14	-12	-10	-28	-26	-24	-42	-40	-38
360	-15	-13	-11	-29	-27	-25	-41	-39	-37

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

Slippery Runway Takeoff

No Reverse Thrust

Weight Adjustment (1000 LB)

DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	-6.4	-6.4	-6.4	-74.5	-74.5	-74.5	-126.1	-126.1	-126.1
800	-11.5	-11.5	-11.5	-73.4	-73.4	-73.4	-120.9	-120.9	-120.9
760	-16.3	-16.3	-16.3	-72.4	-72.4	-72.4	-115.8	-115.8	-115.8
720	-20.5	-20.5	-20.5	-71.5	-71.5	-71.5	-111.2	-111.2	-111.2
680	-23.8	-23.8	-23.8	-70.8	-70.8	-70.8	-107.0	-107.0	-107.0
640	-26.4	-26.4	-26.4	-70.2	-70.2	-70.2	-103.2	-103.2	-103.2
600	-27.7	-27.7	-27.7	-68.3	-68.3	-68.3	-98.4	-98.4	-98.4
560	-27.6	-27.6	-27.6	-64.5	-64.5	-64.5	-92.0	-92.0	-92.0
520	-26.1	-26.1	-26.1	-58.9	-58.9	-58.9	-83.7	-83.7	-83.7
480	-23.2	-23.2	-23.2	-51.3	-51.3	-51.3	-73.8	-73.8	-73.8
440	-18.9	-18.9	-18.9	-42.0	-42.0	-42.0	-62.3	-62.3	-62.3
400	-13.2	-13.2	-13.2	-30.7	-30.7	-30.7	-49.0	-49.0	-49.0
360	-6.0	-6.0	-6.0	-17.5	-17.5	-17.5	-33.9	-33.9	-33.9

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6200	502.7	311.8							
6600	678.3	541.9	365.2						
7000	820.6	708.7	578.6						
7400		847.7	737.9						
7800			874.7						
9400				405.5					
9800				613.9	380.0				
10200				775.2	595.7	353.1			
10600					760.3	577.1			
11000					905.4	745.3			
11400						890.9			
...									
15400							324.8		
15800							570.0	294.2	
16200							738.4	550.3	
16600							879.7	723.4	529.9
17000								865.7	708.0
17400									851.7

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust “Good” field length available by -100 ft/+90 ft for every 5°C above/below 4°C.
Adjust “Medium” field length available by -170 ft/+160 ft for every 5°C above/below 4°C.
Adjust “Poor” field length available by -270 ft/+270 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION**Slippery Runway Takeoff****No Reverse Thrust****V1 Adjustment (KIAS)**

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-10	-6	-2	-27	-23	-19	-52	-48	-44
760	-12	-8	-4	-30	-26	-22	-55	-51	-47
720	-14	-10	-6	-32	-28	-24	-58	-54	-50
680	-15	-11	-7	-35	-31	-27	-61	-57	-53
640	-17	-13	-9	-36	-32	-28	-64	-60	-56
600	-18	-14	-10	-38	-34	-30	-67	-63	-59
560	-18	-14	-10	-40	-36	-32	-69	-65	-61
520	-19	-15	-11	-41	-37	-33	-70	-66	-62
480	-20	-16	-12	-43	-39	-35	-71	-67	-63
440	-21	-17	-13	-44	-40	-36	-71	-67	-63
400	-22	-18	-14	-46	-42	-38	-71	-67	-63
360	-23	-19	-15	-48	-44	-40	-71	-67	-63

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION**TO1 Slush/Standing Water Takeoff****10% Thrust Reduction****Maximum Reverse Thrust****Weight Adjustment (1000 LB)**

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	-78.3	-89.5	-100.7	-93.6	-104.8	-116.0	-119.3	-130.5	-141.7
800	-75.4	-86.6	-97.8	-89.7	-100.9	-112.1	-113.6	-124.8	-136.0
760	-72.7	-83.9	-95.1	-86.1	-97.3	-108.5	-108.3	-119.5	-130.7
720	-70.3	-81.5	-92.7	-82.7	-93.9	-105.1	-103.1	-114.3	-125.5
680	-67.3	-78.5	-89.7	-78.7	-89.9	-101.1	-97.2	-108.4	-119.6
640	-63.5	-74.7	-85.9	-73.8	-85.0	-96.2	-90.3	-101.5	-112.7
600	-58.8	-70.0	-81.2	-68.0	-79.2	-90.4	-82.6	-93.8	-105.0
560	-53.4	-64.6	-75.8	-61.4	-72.6	-83.8	-73.8	-85.0	-96.2
520	-47.2	-58.4	-69.6	-53.9	-65.1	-76.3	-64.2	-75.4	-86.6
480	-40.2	-51.4	-62.6	-45.6	-56.8	-68.0	-53.7	-64.9	-76.1
440	-32.4	-43.6	-54.8	-36.5	-47.7	-58.9	-42.2	-53.4	-64.6
400	-23.8	-35.0	-46.2	-26.5	-37.7	-48.9	-29.9	-41.1	-52.3
360	-14.8	-26.0	-37.2	-16.0	-27.2	-38.4	-17.0	-28.2	-39.4

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5800							313.5		
6200	298.1			325.6			373.3		
6600	356.6			384.7			433.3	319.5	
7000	415.2	303.9		444.3	331.5		494.7	379.3	
7400	475.2	362.4		505.8	390.7		558.0	439.3	325.5
7800	537.5	421.1	309.7	569.5	450.4	337.4	623.5	501.0	385.3
8200	602.5	481.3	368.3	635.8	512.1	396.6	691.1	564.5	445.4
8600	670.4	543.9	427.0	704.9	576.1	456.5	761.3	630.1	507.2
9000	741.8	609.1	487.5	777.2	642.6	518.3	833.8	698.0	570.9
9400	816.8	677.4	550.3	851.9	712.0	582.6	906.6	768.5	636.8
9800	892.7	749.1	615.8		784.7	649.4		841.0	704.9
10200		824.4	684.4		859.4	719.1		913.9	775.7
10600		900.3	756.5			792.2			848.3
11000			832.0			866.9			
11400			907.9						

1. Enter Weight Adjustment table with slush/standing water depth and TO1 dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -180 ft/+170 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff
10% Thrust Reduction
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-22	-20	-18	-17	-15	-13	-9	-7	-5
760	-24	-22	-20	-20	-18	-16	-11	-9	-7
720	-26	-24	-22	-21	-19	-17	-12	-10	-8
680	-27	-25	-23	-23	-21	-19	-14	-12	-10
640	-28	-26	-24	-24	-22	-20	-15	-13	-11
600	-28	-26	-24	-25	-23	-21	-17	-15	-13
560	-28	-26	-24	-25	-23	-21	-18	-16	-14
520	-28	-26	-24	-25	-23	-21	-19	-17	-15
480	-27	-25	-23	-25	-23	-21	-20	-18	-16
440	-26	-24	-22	-24	-22	-20	-20	-18	-16
400	-26	-24	-22	-24	-22	-20	-20	-18	-16
360	-25	-23	-21	-23	-21	-19	-20	-18	-16

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

**TO1 Slush/Standing Water Takeoff
10% Thrust Reduction**

No Reverse Thrust

Weight Adjustment (1000 LB)

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	-111.3	-123.7	-136.1	-130.5	-142.9	-155.3	-162.7	-175.1	-187.5
800	-106.4	-118.8	-131.2	-124.1	-136.5	-148.9	-153.4	-165.8	-178.2
760	-101.6	-114.0	-126.4	-117.8	-130.2	-142.6	-144.3	-156.7	-169.1
720	-96.9	-109.3	-121.7	-111.7	-124.1	-136.5	-135.3	-147.7	-160.1
680	-91.7	-104.1	-116.5	-105.0	-117.4	-129.8	-125.8	-138.2	-150.6
640	-85.8	-98.2	-110.6	-97.7	-110.1	-122.5	-115.7	-128.1	-140.5
600	-79.3	-91.7	-104.1	-89.7	-102.1	-114.5	-105.0	-117.4	-129.8
560	-72.0	-84.4	-96.8	-80.9	-93.3	-105.7	-93.7	-106.1	-118.5
520	-64.1	-76.5	-88.9	-71.5	-83.9	-96.3	-81.8	-94.2	-106.6
480	-55.4	-67.8	-80.2	-61.5	-73.9	-86.3	-69.2	-81.6	-94.0
440	-46.1	-58.5	-70.9	-50.7	-63.1	-75.5	-56.1	-68.5	-80.9
400	-36.1	-48.5	-60.9	-39.3	-51.7	-64.1	-42.4	-54.8	-67.2
360	-25.7	-38.1	-50.5	-27.5	-39.9	-52.3	-28.3	-40.7	-53.1

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
8600							302.3		
9000							375.7		
9400							450.3	324.3	
9800				329.4			528.3	397.8	
10200				410.6			610.1	473.2	346.3
10600	356.7			495.2	353.6		696.5	552.3	420.2
11000	443.9	296.6		585.8	435.3	297.2	788.1	635.4	496.6
11400	537.9	382.5		683.6	521.6	377.9	883.3	723.3	576.8
11800	641.5	471.2	322.2	790.5	614.2	460.6		816.4	661.3
12200	757.9	567.8	408.4	903.3	714.6	548.6		912.1	750.7
12600	886.3	674.7	499.2		824.0	643.4			844.9
13000		795.8	598.6			746.4			
13400			709.4			857.8			
13800			834.4						

1. Enter Weight Adjustment table with slush/standing water depth and TO1 dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -280 ft/+270 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION**TO1 Slush/Standing Water Takeoff****10% Thrust Reduction****No Reverse Thrust****V1 Adjustment (KIAS)**

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-36	-32	-28	-29	-25	-21	-16	-12	-8
760	-39	-35	-31	-32	-28	-24	-18	-14	-10
720	-41	-37	-33	-34	-30	-26	-20	-16	-12
680	-42	-38	-34	-36	-32	-28	-23	-19	-15
640	-43	-39	-35	-37	-33	-29	-25	-21	-17
600	-43	-39	-35	-39	-35	-31	-28	-24	-20
560	-43	-39	-35	-39	-35	-31	-30	-26	-22
520	-43	-39	-35	-40	-36	-32	-32	-28	-24
480	-43	-39	-35	-40	-36	-32	-34	-30	-26
440	-42	-38	-34	-40	-36	-32	-35	-31	-27
400	-41	-37	-33	-39	-35	-31	-35	-31	-27
360	-41	-37	-33	-39	-35	-31	-36	-32	-28

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
10% Thrust Reduction
Maximum Reverse Thrust
Weight Adjustment (1000 LB)

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	0.0	-3.2	-6.4	-39.0	-42.2	-45.4	-79.4	-82.6	-85.8
800	0.0	-3.2	-6.4	-40.0	-43.2	-46.4	-77.2	-80.4	-83.6
760	0.0	-3.2	-6.4	-41.1	-44.3	-47.5	-75.3	-78.5	-81.7
720	-0.9	-4.1	-7.3	-42.4	-45.6	-48.8	-73.8	-77.0	-80.2
680	-6.4	-9.6	-12.8	-43.4	-46.6	-49.8	-72.0	-75.2	-78.4
640	-10.3	-13.5	-16.7	-43.8	-47.0	-50.2	-69.9	-73.1	-76.3
600	-12.3	-15.5	-18.7	-43.6	-46.8	-50.0	-67.4	-70.6	-73.8
560	-13.0	-16.2	-19.4	-42.1	-45.3	-48.5	-63.6	-66.8	-70.0
520	-12.7	-15.9	-19.1	-39.2	-42.4	-45.6	-58.2	-61.4	-64.6
480	-11.4	-14.6	-17.8	-34.8	-38.0	-41.2	-51.3	-54.5	-57.7
440	-9.1	-12.3	-15.5	-29.0	-32.2	-35.4	-42.9	-46.1	-49.3
400	-5.7	-8.9	-12.1	-21.7	-24.9	-28.1	-32.8	-36.0	-39.2
360	-1.3	-4.5	-7.7	-12.9	-16.1	-19.3	-21.1	-24.3	-27.5

ADVISORY INFORMATION**TO1 Slippery Runway Takeoff****10% Thrust Reduction****Maximum Reverse Thrust****V1(MCG) Limit Weight (1000 LB)**

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
4600	364.9								
5000	488.8	364.9							
5400	611.7	488.8	364.9						
5800	733.7	611.7	488.8	310.5					
6200	855.0	733.7	611.7	389.4					
6600		855.0	733.7	470.9	357.7				
7000			855.0	556.1	437.9	326.3	284.0		
7400				645.6	521.6	405.4	331.5		
7800				740.0	609.2	487.6	379.1		
8200				839.5	701.6	573.7	428.1	322.0	
8600					799.4	664.1	479.0	369.5	
9000					899.6	759.6	532.1	418.1	312.5
9400						859.5	587.5	468.6	360.0
9800							645.8	521.3	408.3
10200							707.4	576.2	458.4
10600							772.8	633.9	510.6
11000							841.4	694.8	565.0
11400							910.2	759.4	622.2
11800								827.7	682.3
12200								896.5	746.1
12600									813.9
13000									882.7

1. Enter Weight Adjustment table with reported braking action and TO1 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -90 ft/+90 ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -130 ft/+120 ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -190 ft/+180 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
10% Thrust Reduction
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-6	-4	-2	-16	-14	-12	-29	-27	-25
760	-8	-6	-4	-19	-17	-15	-32	-30	-28
720	-9	-7	-5	-20	-18	-16	-34	-32	-30
680	-10	-8	-6	-22	-20	-18	-35	-33	-31
640	-11	-9	-7	-23	-21	-19	-37	-35	-33
600	-11	-9	-7	-23	-21	-19	-37	-35	-33
560	-12	-10	-8	-24	-22	-20	-38	-36	-34
520	-12	-10	-8	-24	-22	-20	-38	-36	-34
480	-12	-10	-8	-24	-22	-20	-38	-36	-34
440	-12	-10	-8	-25	-23	-21	-38	-36	-34
400	-13	-11	-9	-25	-23	-21	-38	-36	-34
360	-13	-11	-9	-26	-24	-22	-38	-36	-34

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION**TO1 Slippery Runway Takeoff****10% Thrust Reduction****No Reverse Thrust****Weight Adjustment (1000 LB)**

TO1 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	0.0	0.0	0.0	-68.2	-68.2	-68.2	-120.4	-120.4	-120.4
800	-3.6	-3.6	-3.6	-67.1	-67.1	-67.1	-115.5	-115.5	-115.5
760	-8.7	-8.7	-8.7	-66.3	-66.3	-66.3	-110.9	-110.9	-110.9
720	-13.7	-13.7	-13.7	-65.8	-65.8	-65.8	-106.5	-106.5	-106.5
680	-18.2	-18.2	-18.2	-65.5	-65.5	-65.5	-102.6	-102.6	-102.6
640	-21.8	-21.8	-21.8	-65.3	-65.3	-65.3	-99.2	-99.2	-99.2
600	-24.5	-24.5	-24.5	-65.2	-65.2	-65.2	-96.2	-96.2	-96.2
560	-25.9	-25.9	-25.9	-63.7	-63.7	-63.7	-91.9	-91.9	-91.9
520	-25.8	-25.8	-25.8	-60.1	-60.1	-60.1	-85.7	-85.7	-85.7
480	-24.2	-24.2	-24.2	-54.4	-54.4	-54.4	-77.7	-77.7	-77.7
440	-21.1	-21.1	-21.1	-46.7	-46.7	-46.7	-67.7	-67.7	-67.7
400	-16.4	-16.4	-16.4	-36.9	-36.9	-36.9	-55.8	-55.8	-55.8
360	-10.2	-10.2	-10.2	-24.9	-24.9	-24.9	-41.8	-41.8	-41.8

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5800	519.6	314.6							
6200	705.4	561.1	372.9						
6600	857.4	737.4	600.0						
7000		887.0	768.3						
7400			916.7						
8600				341.7					
9000				588.1	311.8				
9400				769.2	567.4	282.0			
9800					752.8	546.0			
10200					912.9	736.0			
10600						896.9			
...									
14200							401.0		
14600							637.8	369.0	
15000							808.0	618.2	335.0
15400								792.4	597.9
15800									776.8

1. Enter Weight Adjustment table with reported braking action and TO1 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -100 ft/+90 ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -170 ft/+160 ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -270 ft/+270 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
10% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-9	-5	-1	-24	-20	-16	-47	-43	-39
760	-11	-7	-3	-26	-22	-18	-50	-46	-42
720	-12	-8	-4	-29	-25	-21	-53	-49	-45
680	-14	-10	-6	-31	-27	-23	-56	-52	-48
640	-15	-11	-7	-32	-28	-24	-58	-54	-50
600	-16	-12	-8	-34	-30	-26	-61	-57	-53
560	-16	-12	-8	-35	-31	-27	-63	-59	-55
520	-17	-13	-9	-37	-33	-29	-64	-60	-56
480	-18	-14	-10	-38	-34	-30	-65	-61	-57
440	-18	-14	-10	-40	-36	-32	-65	-61	-57
400	-19	-15	-11	-41	-37	-33	-65	-61	-57
360	-20	-16	-12	-43	-39	-35	-65	-61	-57

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION**TO2 Slush/Standing Water Takeoff****20% Thrust Reduction****Maximum Reverse Thrust****Weight Adjustment (1000 LB)**

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	-74.8	-86.0	-97.2	-90.1	-101.3	-112.5	-116.1	-127.3	-138.5
800	-71.8	-83.0	-94.2	-86.1	-97.3	-108.5	-110.2	-121.4	-132.6
760	-68.9	-80.1	-91.3	-82.2	-93.4	-104.6	-104.5	-115.7	-126.9
720	-66.2	-77.4	-88.6	-78.6	-89.8	-101.0	-99.3	-110.5	-121.7
680	-64.0	-75.2	-86.4	-75.6	-86.8	-98.0	-94.6	-105.8	-117.0
640	-61.6	-72.8	-84.0	-72.2	-83.4	-94.6	-89.5	-100.7	-111.9
600	-58.3	-69.5	-80.7	-67.9	-79.1	-90.3	-83.2	-94.4	-105.6
560	-54.1	-65.3	-76.5	-62.5	-73.7	-84.9	-76.0	-87.2	-98.4
520	-48.9	-60.1	-71.3	-56.2	-67.4	-78.6	-67.5	-78.7	-89.9
480	-42.8	-54.0	-65.2	-48.8	-60.0	-71.2	-58.1	-69.3	-80.5
440	-35.8	-47.0	-58.2	-40.6	-51.8	-63.0	-47.6	-58.8	-70.0
400	-27.9	-39.1	-50.3	-31.3	-42.5	-53.7	-36.0	-47.2	-58.4
360	-19.2	-30.4	-41.6	-21.1	-32.3	-43.5	-23.5	-34.7	-45.9

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5400							315.6		
5800	306.4			334.0			381.9		
6200	371.3			399.6			448.5	322.3	
6600	436.5	312.9		466.1	340.6		517.2	388.5	
7000	504.0	377.8		535.2	406.2	281.7	588.3	455.3	328.9
7400	574.5	443.1	319.4	607.3	472.9	347.1	662.0	524.2	395.1
7800	648.6	510.9	384.3	682.7	542.3	412.7	738.8	595.5	462.1
8200	726.6	581.7	449.7	761.9	614.7	479.7	818.6	669.6	531.2
8600	809.2	656.1	517.8	844.5	690.5	549.4	899.3	746.6	602.8
9000	893.4	734.7	589.0		770.0	622.1		826.7	677.1
9400		817.6	663.8		852.7	698.2		907.4	754.5
9800		901.8	742.8			778.2			834.7
10200			826.0			861.0			915.5
10600			910.2						

1. Enter Weight Adjustment table with slush/standing water depth and TO2 dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -180 ft/+170 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

20% Thrust Reduction

Maximum Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-19	-17	-15	-14	-12	-10	-5	-3	-1
760	-21	-19	-17	-16	-14	-12	-6	-4	-2
720	-23	-21	-19	-18	-16	-14	-8	-6	-4
680	-24	-22	-20	-20	-18	-16	-10	-8	-6
640	-25	-23	-21	-21	-19	-17	-11	-9	-7
600	-26	-24	-22	-22	-20	-18	-13	-11	-9
560	-25	-23	-21	-22	-20	-18	-14	-12	-10
520	-25	-23	-21	-22	-20	-18	-15	-13	-11
480	-24	-22	-20	-22	-20	-18	-16	-14	-12
440	-23	-21	-19	-21	-19	-17	-17	-15	-13
400	-23	-21	-19	-21	-19	-17	-17	-15	-13
360	-22	-20	-18	-20	-18	-16	-17	-15	-13

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION**TO2 Slush/Standing Water Takeoff****20% Thrust Reduction****No Reverse Thrust****Weight Adjustment (1000 LB)**

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	-109.4	-121.8	-134.2	-129.3	-141.7	-154.1	-163.0	-175.4	-187.8
800	-104.3	-116.7	-129.1	-122.7	-135.1	-147.5	-153.5	-165.9	-178.3
760	-99.3	-111.7	-124.1	-116.2	-128.6	-141.0	-144.3	-156.7	-169.1
720	-94.5	-106.9	-119.3	-109.9	-122.3	-134.7	-135.2	-147.6	-160.0
680	-89.9	-102.3	-114.7	-103.8	-116.2	-128.6	-126.2	-138.6	-151.0
640	-85.0	-97.4	-109.8	-97.5	-109.9	-122.3	-117.0	-129.4	-141.8
600	-79.3	-91.7	-104.1	-90.3	-102.7	-115.1	-107.1	-119.5	-131.9
560	-72.8	-85.2	-97.6	-82.4	-94.8	-107.2	-96.5	-108.9	-121.3
520	-65.6	-78.0	-90.4	-73.7	-86.1	-98.5	-85.2	-97.6	-110.0
480	-57.6	-70.0	-82.4	-64.3	-76.7	-89.1	-73.3	-85.7	-98.1
440	-48.9	-61.3	-73.7	-54.1	-66.5	-78.9	-60.7	-73.1	-85.5
400	-39.4	-51.8	-64.2	-43.2	-55.6	-68.0	-47.4	-59.8	-72.2
360	-29.1	-41.5	-53.9	-31.6	-44.0	-56.4	-33.5	-45.9	-58.3

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
7800							295.8		
8200							383.1		
8600							473.0	322.0	
9000				370.5			569.3	409.6	
9400	333.9			472.2	302.1		673.2	501.3	348.2
9800	441.8			583.6	400.5		786.0	599.7	436.6
10200	561.3	365.8		707.9	504.5	331.3	905.9	706.0	530.1
10600	699.2	476.0	291.8	848.1	619.3	430.6		821.4	630.6
11000	862.5	600.4	397.7		748.3	537.4			739.4
11400		745.9	511.6		892.3	656.4			857.4
11800		913.7	641.6			790.6			
12200			794.8						

1. Enter Weight Adjustment table with slush/standing water depth and TO2 dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by -280 ft/+270 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

20% Thrust Reduction

No Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-31	-27	-23	-23	-19	-15	-7	-3	0
760	-34	-30	-26	-26	-22	-18	-10	-6	-2
720	-36	-32	-28	-29	-25	-21	-12	-8	-4
680	-37	-33	-29	-31	-27	-23	-15	-11	-7
640	-38	-34	-30	-32	-28	-24	-18	-14	-10
600	-39	-35	-31	-34	-30	-26	-21	-17	-13
560	-39	-35	-31	-34	-30	-26	-24	-20	-16
520	-39	-35	-31	-35	-31	-27	-26	-22	-18
480	-38	-34	-30	-35	-31	-27	-28	-24	-20
440	-38	-34	-30	-35	-31	-27	-29	-25	-21
400	-37	-33	-29	-35	-31	-27	-30	-26	-22
360	-36	-32	-28	-34	-30	-26	-31	-27	-23

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION**TO2 Slippery Runway Takeoff****20% Thrust Reduction****Maximum Reverse Thrust****Weight Adjustment (1000 LB)**

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	0.0	-3.2	-6.4	-34.0	-37.2	-40.4	-75.3	-78.5	-81.7
800	0.0	-3.2	-6.4	-35.0	-38.2	-41.4	-73.1	-76.3	-79.5
760	0.0	-3.2	-6.4	-36.0	-39.2	-42.4	-70.9	-74.1	-77.3
720	0.0	-3.2	-6.4	-37.0	-40.2	-43.4	-69.1	-72.3	-75.5
680	0.0	-3.2	-6.4	-38.6	-41.8	-45.0	-67.9	-71.1	-74.3
640	-5.6	-8.8	-12.0	-39.9	-43.1	-46.3	-66.6	-69.8	-73.0
600	-9.6	-12.8	-16.0	-40.6	-43.8	-47.0	-64.9	-68.1	-71.3
560	-11.5	-14.7	-17.9	-40.6	-43.8	-47.0	-62.8	-66.0	-69.2
520	-12.2	-15.4	-18.6	-39.2	-42.4	-45.6	-59.1	-62.3	-65.5
480	-11.8	-15.0	-18.2	-36.3	-39.5	-42.7	-53.8	-57.0	-60.2
440	-10.3	-13.5	-16.7	-31.7	-34.9	-38.1	-46.7	-49.9	-53.1
400	-7.7	-10.9	-14.1	-25.5	-28.7	-31.9	-37.9	-41.1	-44.3
360	-4.0	-7.2	-10.4	-17.8	-21.0	-24.2	-27.4	-30.6	-33.8

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
4200	324.0								
4600	455.9	324.0							
5000	586.8	455.9	324.0						
5400	716.7	586.8	455.9	299.5					
5800	845.8	716.7	586.8	383.3					
6200		845.8	716.7	470.0	349.7				
6600			845.8	560.9	434.9	316.2	286.7		
7000				656.8	524.0	400.4	337.3		
7400				758.6	617.9	487.8	388.3		
7800				865.4	717.1	579.7	441.1	327.2	
8200					822.5	676.7	496.2	378.0	
8600						779.7	553.9	430.4	317.0
9000						886.8	614.6	485.0	367.7
9400							678.8	542.1	419.7
9800							747.2	602.2	473.8
10200							820.2	665.6	530.5
10600							894.1	733.1	589.9
11000								805.4	652.6
11400								879.3	719.3
11800									790.6
12200									864.5

1. Enter Weight Adjustment table with reported braking action and TO2 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -90 ft/+90 ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -130 ft/+120 ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -190 ft/+180 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
20% Thrust Reduction
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-6	-4	-2	-15	-13	-11	-27	-25	-23
760	-7	-5	-3	-17	-15	-13	-29	-27	-25
720	-9	-7	-5	-19	-17	-15	-31	-29	-27
680	-9	-7	-5	-20	-18	-16	-32	-30	-28
640	-10	-8	-6	-21	-19	-17	-33	-31	-29
600	-10	-8	-6	-21	-19	-17	-34	-32	-30
560	-11	-9	-7	-22	-20	-18	-35	-33	-31
520	-11	-9	-7	-22	-20	-18	-35	-33	-31
480	-11	-9	-7	-22	-20	-18	-35	-33	-31
440	-11	-9	-7	-23	-21	-19	-35	-33	-31
400	-12	-10	-8	-23	-21	-19	-35	-33	-31
360	-12	-10	-8	-23	-21	-19	-35	-33	-31

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

ADVISORY INFORMATION**TO2 Slippery Runway Takeoff****20% Thrust Reduction****No Reverse Thrust****Weight Adjustment (1000 LB)**

TO2 DRY FIELD/OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
840	0.0	0.0	0.0	-64.0	-64.0	-64.0	-117.7	-117.7	-117.7
800	0.0	0.0	0.0	-63.0	-63.0	-63.0	-112.5	-112.5	-112.5
760	-1.6	-1.6	-1.6	-61.9	-61.9	-61.9	-107.6	-107.6	-107.6
720	-6.7	-6.7	-6.7	-61.0	-61.0	-61.0	-103.1	-103.1	-103.1
680	-11.8	-11.8	-11.8	-60.7	-60.7	-60.7	-99.0	-99.0	-99.0
640	-16.4	-16.4	-16.4	-60.6	-60.6	-60.6	-95.4	-95.4	-95.4
600	-20.2	-20.2	-20.2	-60.7	-60.7	-60.7	-92.4	-92.4	-92.4
560	-23.0	-23.0	-23.0	-60.9	-60.9	-60.9	-89.7	-89.7	-89.7
520	-24.4	-24.4	-24.4	-59.4	-59.4	-59.4	-85.6	-85.6	-85.6
480	-24.1	-24.1	-24.1	-55.6	-55.6	-55.6	-79.4	-79.4	-79.4
440	-22.2	-22.2	-22.2	-49.6	-49.6	-49.6	-71.1	-71.1	-71.1
400	-18.6	-18.6	-18.6	-41.4	-41.4	-41.4	-60.7	-60.7	-60.7
360	-13.5	-13.5	-13.5	-30.9	-30.9	-30.9	-48.1	-48.1	-48.1

V1(MCG) Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5400	522.5	295.8							
5800	723.4	567.7	359.8						
6200	888.7	757.9	610.0						
6600			790.9						
8200				528.9					
8600				740.6	503.8				
9000				918.2	721.8	477.7			
9400					900.6	702.6			
9800						882.9			
...									
13000							416.2		
13400							669.3	381.7	
13800							852.7	648.5	344.2
14200								835.2	627.0
14600									817.8

1. Enter Weight Adjustment table with reported braking action and TO2 dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust "Good" field length available by -100 ft/+90 ft for every 5°C above/below 4°C.
Adjust "Medium" field length available by -170 ft/+160 ft for every 5°C above/below 4°C.
Adjust "Poor" field length available by -270 ft/+270 ft for every 5°C above/below 4°C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
20% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
800	-8	-4	0	-21	-17	-13	-42	-38	-34
760	-10	-6	-2	-23	-19	-15	-44	-40	-36
720	-11	-7	-3	-26	-22	-18	-47	-43	-39
680	-12	-8	-4	-27	-23	-19	-50	-46	-42
640	-13	-9	-5	-29	-25	-21	-52	-48	-44
600	-14	-10	-6	-30	-26	-22	-55	-51	-47
560	-15	-11	-7	-32	-28	-24	-56	-52	-48
520	-15	-11	-7	-33	-29	-25	-58	-54	-50
480	-16	-12	-8	-34	-30	-26	-58	-54	-50
440	-16	-12	-8	-35	-31	-27	-58	-54	-50
400	-17	-13	-9	-37	-33	-29	-58	-54	-50
360	-18	-14	-10	-38	-34	-30	-58	-54	-50

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

Minimum Control Speeds**V1(MCG), Minimum VR****Max Takeoff Thrust**

TEMP		PRESSURE ALTITUDE (FT)											
		-2000		0		2000		4000		6000		8000	
°C	°F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	116	118	113	115	111	113	109	111				
50	122	119	121	116	118	111	113	109	111	106	109	103	106
40	104	126	127	123	124	118	120	113	115	108	111	103	106
30	86	128	130	128	130	123	125	118	120	112	115	106	109
20	68	129	130	129	130	125	126	120	122	116	118	110	113
-60	-76	130	130	130	130	126	126	121	122	117	118	112	114

TO1 V1(MCG), Minimum VR**10% Thrust Reduction**

TEMP		PRESSURE ALTITUDE (FT)											
		-2000		0		2000		4000		6000		8000	
°C	°F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	111	112	107	110	105	107	103	106				
50	122	113	115	110	112	105	108	103	106	101	104	98	101
40	104	119	121	117	119	112	114	107	110	103	105	98	101
30	86	122	123	121	123	116	118	112	114	107	109	101	104
20	68	122	124	121	123	118	119	114	116	110	112	104	107
-60	-76	124	124	123	123	119	120	115	116	111	112	106	108

TO2 V1(MCG), Minimum VR**20% Thrust Reduction**

TEMP		PRESSURE ALTITUDE (FT)											
		-2000		0		2000		4000		6000		8000	
°C	°F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	105	107	102	104	100	102	98	101				
50	122	107	109	104	107	100	103	98	101	96	99	93	96
40	104	113	115	110	112	106	108	102	104	97	100	93	96
30	86	115	117	114	116	110	112	106	108	101	104	96	99
20	68	116	117	115	116	111	113	108	110	104	106	99	102
-60	-76	117	118	116	117	113	114	109	111	105	107	101	103

Go-Around %N1**Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off**

REPORTED OAT		TAT (°C)	AIRPORT PRESSURE ALTITUDE (1000 FT)												
°C	°F		-2	-1	0	1	2	3	4	5	6	7	8	9	10
66	150	70	93.7	93.8	94.1	93.9	93.8	93.7	93.6	93.4	93.3	92.6	91.5	90.5	89.6
56	133	60	96.5	96.6	96.9	96.7	96.6	96.5	96.4	96.2	96.1	95.4	94.3	93.4	92.5
51	124	55	97.8	98.0	98.3	98.1	97.9	97.9	97.7	97.6	97.4	96.7	95.7	94.7	93.9
46	115	50	99.1	99.3	99.6	99.4	99.3	99.2	99.1	98.9	98.7	98.0	97.0	96.1	95.2
41	106	45	100.2	100.7	101.1	101.0	100.9	100.7	100.5	100.4	100.0	99.3	98.3	97.3	96.5
36	97	40	101.5	102.4	103.2	103.2	102.8	102.6	102.3	102.0	101.4	100.5	99.5	98.6	97.8
31	88	35	101.2	103.9	105.8	105.4	105.1	104.7	104.3	103.8	102.7	101.7	100.6	99.7	98.9
26	79	30	100.4	103.1	105.9	106.8	107.3	106.8	106.6	106.4	105.0	103.4	101.9	100.8	100.0
21	70	25	99.5	102.2	105.0	105.9	106.5	107.0	107.4	107.4	106.8	105.7	104.0	102.3	101.3
16	61	20	98.7	101.4	104.1	105.0	105.6	106.1	106.5	107.0	106.8	106.3	105.2	104.2	103.3
11	53	15	97.9	100.5	103.2	104.1	104.7	105.2	105.6	106.1	105.9	105.5	104.9	104.4	104.0
7	44	10	97.0	99.6	102.3	103.2	103.8	104.3	104.7	105.1	105.0	104.6	104.0	103.5	103.4
2	35	5	96.1	98.7	101.4	102.3	102.9	103.4	103.8	104.2	104.1	103.7	103.1	102.6	102.5
-3	26	0	95.3	97.8	100.5	101.4	102.0	102.4	102.8	103.3	103.1	102.7	102.2	101.7	101.6
-13	8	-10	93.5	96.0	98.6	99.5	100.1	100.5	100.9	101.4	101.2	100.8	100.3	99.8	99.7
-23	-10	-20	91.7	94.2	96.7	97.6	98.2	98.6	99.0	99.4	99.3	98.9	98.3	97.9	97.8
-33	-27	-30	89.9	92.3	94.8	95.6	96.2	96.6	97.0	97.4	97.3	96.9	96.4	95.9	95.8
-43	-45	-40	88.0	90.4	92.8	93.6	94.2	94.6	95.0	95.4	95.3	94.9	94.4	93.9	93.9
-53	-63	-50	86.1	88.4	90.8	91.6	92.2	92.6	93.0	93.3	93.2	92.9	92.3	91.9	91.8

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)												
	-2	-1	0	1	2	3	4	5	6	7	8	9	10
PACKS OFF	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
1 PACK ON	-0.2	-0.2	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3	-0.3
WING ANTI-ICE ON	-0.2	-0.3	-0.4	-0.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4

Max Climb %N1**Based on engine bleed for packs on or off and anti-ice off**

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)									
	0	5	10	15	20	25	30	35	40	43
	310	310	310	310	310	310	310	0.84	0.84	0.84
60	88.3	88.1	90.3	91.0	93.1	96.7	99.6	101.7	101.8	101.3
50	90.6	90.4	90.2	89.6	91.7	95.3	98.0	100.1	100.2	99.7
40	92.5	92.4	92.4	92.2	90.5	93.8	96.5	98.6	98.7	98.2
30	91.6	94.1	94.2	94.0	93.1	94.2	95.2	97.0	97.1	96.6
20	90.1	92.5	95.1	95.8	95.9	95.9	96.9	95.9	95.5	95.0
15	89.3	91.7	94.3	96.9	96.9	96.9	97.8	96.6	95.8	95.4
10	88.6	90.9	93.5	96.1	98.4	98.1	98.8	97.2	96.5	96.0
5	87.8	90.1	92.7	95.2	98.1	99.6	100.1	98.1	97.2	96.8
0	87.0	89.3	91.8	94.4	97.3	99.9	101.5	99.3	98.1	97.6
-5	86.2	88.5	91.0	93.5	96.4	99.0	101.9	100.5	99.5	98.8
-10	85.4	87.7	90.1	92.6	95.5	98.1	100.9	101.3	100.5	100.0
-15	84.6	86.8	89.3	91.7	94.5	97.1	100.0	101.0	100.9	100.5
-20	83.7	86.0	88.4	90.8	93.6	96.2	99.0	100.1	99.9	99.5
-25	82.9	85.1	87.5	89.9	92.7	95.2	98.0	99.1	98.9	98.5
-30	82.1	84.3	86.7	89.0	91.8	94.3	97.0	98.1	97.9	97.5
-35	81.2	83.4	85.8	88.1	90.8	93.3	96.0	97.0	96.9	96.5
-40	80.4	82.5	84.9	87.2	89.8	92.3	95.0	96.0	95.9	95.5

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)									
	0	5	10	15	20	25	30	35	40	43
2 PACKS ON - 1 BLEED SOURCE	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4	-0.4	-0.5
1 PACK ON - 1 OR 2 BLEED SOURCES	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4	-0.4	-0.5
ENGINE ANTI-ICE ON	-0.3	-0.5	-0.4	-0.3	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
ENGINE & WING ANTI-ICE ON*	-0.6	-0.8	-0.7	-0.5	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4
ENGINE & WING ANTI-ICE ON**	-1.1	-0.9	-0.9	-0.6	-0.3	-0.4	-0.5	-0.5	-0.6	-0.6

*Packs on or off with 2 bleed sources.

**Packs off with 1 bleed source.

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 LB)				
		400	500	600	700	800
40000 (.82M)	PITCH ATT	4.5	4.0			
	V/S (FT/MIN)	1100	700			
30000 (280 KIAS)	PITCH ATT	5.5	5.0	5.0	4.5	4.0
	V/S (FT/MIN)	2800	2100	1500	1100	800
20000 (270 KIAS)	PITCH ATT	8.5	7.5	7.5	7.5	7.0
	V/S (FT/MIN)	4100	3100	2400	1700	1300
10000 (270 KIAS)	PITCH ATT	11.5	10.5	9.5	9.5	9.0
	V/S (FT/MIN)	5400	4100	3300	2600	2100
SEA LEVEL (270 KIAS)	PITCH ATT	15.0	13.0	12.0	11.5	11.0
	V/S (FT/MIN)	6300	4900	3900	3200	2600

Cruise

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 LB)				
		400	500	600	700	800
40000 (.82M)	PITCH ATT	2.5	3.0			
	%N1	82.1	87.2			
35000 (280 KIAS)	PITCH ATT	1.5	2.5	3.0	3.5	
	%N1	78.9	81.6	85.3	92.0	
30000 (280 KIAS)	PITCH ATT	2.0	2.5	3.0	3.0	3.0
	%N1	74.5	77.2	80.7	84.8	88.8
25000 (280 KIAS)	PITCH ATT	2.0	2.5	3.5	3.5	3.5
	%N1	70.6	73.0	76.1	80.0	83.7
20000 (270 KIAS)	PITCH ATT	2.0	3.0	4.0	4.0	4.0
	%N1	65.8	68.3	71.4	75.2	78.9
15000 (270 KIAS)	PITCH ATT	2.0	3.0	4.0	4.5	4.5
	%N1	61.8	64.4	67.2	70.4	74.3

Descent

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 LB)				
		400	500	600	700	800
40000 (.82M)	PITCH ATT	-1.0	0.0			
	V/S (FT/MIN)	-2700	-2700			
30000 (280 KIAS)	PITCH ATT	-1.0	0.0	1.0	0.5	0.5
	V/S (FT/MIN)	-2200	-2000	-1900	-2100	-2500
20000 (270 KIAS)	PITCH ATT	-0.5	0.5	1.5	2.0	1.5
	V/S (FT/MIN)	-1800	-1600	-1500	-1500	-1600
10000 (270 KIAS)	PITCH ATT	-1.0	0.0	1.5	2.5	2.5
	V/S (FT/MIN)	-1600	-1400	-1400	-1400	-1400
SEA LEVEL (270 KIAS)	PITCH ATT	-1.0	0.0	1.0	2.0	2.5
	V/S (FT/MIN)	-1400	-1300	-1200	-1200	-1300

In shaded areas, data reflects the minimum speed limitation of 15 knots above minimum maneuvering speed.

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Holding**Flaps Up, Set Thrust for Level Flight**

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB)				
		400	500	600	700	800
10000	PITCH ATT	4.5	5.0	5.5	5.5	5.5
	%N1	52.8	57.5	62.0	66.1	69.7
	KIAS	207	222	238	258	276
5000	PITCH ATT	4.5	5.0	5.5	5.5	5.5
	%N1	49.3	53.8	58.0	61.9	65.6
	KIAS	207	222	237	256	274

Terminal Area (5000 FT)**Set Thrust for Level Flight**

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 LB)				
		400	500	600	700	800
FLAPS UP	PITCH ATT	5.0	5.5	6.0	6.0	6.5
GEAR UP	%N1	50.3	55.2	59.5	63.8	67.6
VREF30+80	KIAS	208	223	237	253	266
FLAPS 1	PITCH ATT	6.5	7.0	7.5	7.5	8.0
GEAR UP	%N1	51.2	56.4	61.1	65.5	69.3
VREF30+60	KIAS	188	203	217	233	246
FLAPS 5	PITCH ATT	5.5	6.0	6.5	6.5	6.5
GEAR UP	%N1	51.9	57.0	62.2	66.3	70.3
VREF30+40	KIAS	168	183	197	213	226
FLAPS 15	PITCH ATT	6.5	7.0	7.0	7.0	7.0
GEAR UP	%N1	52.9	58.7	63.7	68.1	72.4
VREF30+20	KIAS	148	163	177	193	206
FLAPS 20	PITCH ATT	5.0	5.0	5.5	5.0	5.5
GEAR DOWN	%N1	58.8	64.9	70.4	75.3	79.5
VREF30+20	KIAS	148	163	177	193	206

Final Approach (1500 FT)**Gear Down, Set Thrust for 3° Glideslope**

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 LB)				
		400	500	600	700	800
FLAPS 20 VREF20+10	PITCH ATT	1.0	1.0	1.5	1.5	2.0
	%N1	39.2	43.4	47.2	50.5	53.3
	KIAS	154	171	186	200	210
FLAPS 25 VREF25+10	PITCH ATT	1.5	2.0	2.0	2.0	2.0
	%N1	49.2	53.8	57.7	61.3	64.0
	KIAS	145	160	174	187	197
FLAPS 30 VREF30+10	PITCH ATT	1.0	1.5	1.5		
	%N1	53.4	58.6	62.8		
	KIAS	138	153	166		

Intentionally
Blank

Performance Inflight
All Engine

Chapter PI
Section 61

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 10°C and Below

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
780	28300	3	30800	29100	27600
760	28800	2	31300	29700	28200
740	29400	0	31800	30200	28700
720	30000	-1	32300	30700	29100
700	30700	-2	32800	31100	29600
680	31300	-4	33200	31600	30100
660	31900	-5	33700	32100	30600
640	32600	-7	34300	32700	31200
620	33300	-8	34800	33200	31700
600	34000	-10	35300	33800	32300
580	34700	-11	35900	34300	32900
560	35400	-13	36500	34900	33500
540	36200	-15	37100	35600	34100
520	37000	-15	37800	36200	34800
500	37800	-15	38400	36900	35500
480	38600	-15	39100	37600	36200
460	39500	-15	39900	38300	37000
440	40400	-15	40600	39100	37700
420	41400	-15	41400	39900	38600
400	42400	-15	42300	40800	39500
380	43100	-15	43100	41800	40500

ISA + 15°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
780	28300	9	30800	29100	27600
760	28800	8	31300	29700	28200
740	29400	6	31800	30200	28700
720	30000	5	32300	30700	29100
700	30700	3	32800	31100	29600
680	31300	2	33200	31600	30100
660	31900	1	33700	32100	30600
640	32600	-1	34300	32700	31200
620	33300	-2	34800	33200	31700
600	34000	-4	35300	33800	32300
580	34700	-6	35900	34300	32900
560	35400	-7	36500	34900	33500
540	36200	-9	37100	35600	34100
520	37000	-9	37800	36200	34800
500	37800	-9	38400	36900	35500
480	38600	-9	39100	37600	36200
460	39500	-9	39900	38300	37000
440	40400	-9	40600	39100	37700
420	41400	-9	41400	39900	38600
400	42400	-9	42300	40800	39500
380	43100	-9	43100	41800	40500

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
780	28300	15	30800	29100	27600
760	28800	13	31300	29700	28200
740	29400	12	31800	30200	28700
720	30000	11	32300	30700	29100
700	30700	9	32800	31100	29600
680	31300	8	33200	31600	30100
660	31900	6	33700	32100	30600
640	32600	5	34300	32700	31200
620	33300	3	34800	33200	31700
600	34000	2	35300	33800	32300
580	34700	0	35900	34300	32900
560	35400	-2	36500	34900	33500
540	36200	-3	37100	35600	34100
520	37000	-3	37800	36200	34800
500	37800	-3	38400	36900	35500
480	38600	-3	39100	37600	36200
460	39500	-3	39900	38300	37000
440	40400	-3	40600	39100	37700
420	41400	-3	41400	39900	38600
400	42400	-3	42300	40800	39500
380	43100	-3	43100	41800	40500

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)									
		25	27	29	31	33	35	37	39	41	43
780	%N1	84.2	85.9	87.1	89.6						
	MACH	.819	.840	.839	.838						
	KIAS	346	342	327	313						
	FF/ENG	11439	11411	11201	11537						
740	%N1	83.4	84.8	85.9	87.7	90.7					
	MACH	.819	.837	.840	.839	.837					
	KIAS	346	341	328	313	299					
	FF/ENG	11096	10974	10668	10708	11189					
700	%N1	82.5	83.7	84.9	86.1	88.3					
	MACH	.812	.831	.839	.840	.838					
	KIAS	343	338	327	314	300					
	FF/ENG	10640	10513	10229	10021	10265					
660	%N1	81.0	82.5	83.7	84.9	86.4	89.1				
	MACH	.795	.819	.835	.840	.839	.837				
	KIAS	335	332	325	314	300	286				
	FF/ENG	10011	9983	9794	9536	9480	9831				
620	%N1	79.4	81.1	82.5	83.8	84.9	86.7				
	MACH	.775	.803	.825	.838	.840	.839				
	KIAS	326	325	321	313	300	287				
	FF/ENG	9341	9384	9307	9103	8893	8984				
580	%N1	77.6	79.4	81.1	82.4	83.6	84.8	87.5			
	MACH	.751	.782	.809	.830	.839	.840	.838			
	KIAS	315	316	314	310	300	287	274			
	FF/ENG	8646	8743	8740	8651	8448	8289	8522			
540	%N1	75.9	77.5	79.3	81.0	82.3	83.4	85.2	88.6		
	MACH	.728	.757	.788	.814	.833	.840	.839	.837		
	KIAS	305	305	305	303	298	287	274	261		
	FF/ENG	8016	8060	8128	8113	8011	7814	7757	8113		
500	%N1	74.4	75.7	77.3	79.1	80.7	82.1	83.5	85.9		
	MACH	.709	.731	.761	.792	.818	.835	.840	.839		
	KIAS	296	294	294	294	292	285	274	262		
	FF/ENG	7478	7417	7468	7518	7504	7376	7226	7293		
460	%N1	72.8	74.0	75.3	77.0	78.9	80.4	82.1	84.0	86.5	
	MACH	.691	.710	.733	.764	.795	.821	.836	.840	.839	
	KIAS	288	285	282	283	283	280	273	262	250	
	FF/ENG	6982	6872	6822	6874	6918	6892	6790	6706	6803	
420	%N1	70.8	72.3	73.5	74.8	76.5	78.4	80.3	82.4	84.2	86.8
	MACH	.669	.690	.710	.733	.764	.796	.822	.837	.840	.839
	KIAS	278	276	273	270	271	271	268	261	250	238
	FF/ENG	6457	6375	6276	6235	6280	6311	6314	6265	6188	6260
380	%N1	68.5	70.1	71.6	72.8	74.2	75.9	78.2	80.4	82.5	84.3
	MACH	.639	.665	.688	.708	.731	.762	.795	.821	.836	.840
	KIAS	266	266	264	260	258	258	258	255	249	239
	FF/ENG	5889	5850	5779	5697	5655	5676	5727	5783	5742	5644
340	%N1	65.9	67.6	69.2	70.7	72.0	73.3	75.3	78.0	80.3	82.5
	MACH	.604	.632	.659	.683	.704	.726	.757	.790	.817	.835
	KIAS	250	251	252	251	247	244	244	245	242	237
	FF/ENG	5299	5296	5253	5205	5135	5071	5094	5184	5243	5194

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitudes
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
282	261	242	226	213	200	191	182	174	167	160
561	520	484	452	425	400	382	366	351	337	325
840	779	725	678	637	600	574	550	528	508	489
1120	1039	966	904	849	800	766	734	705	678	653
1401	1299	1208	1130	1062	1000	957	918	881	848	817
1683	1560	1451	1357	1274	1200	1149	1101	1057	1017	980
1966	1822	1694	1583	1487	1400	1340	1285	1234	1187	1144
2250	2085	1937	1811	1700	1600	1532	1469	1410	1356	1307
2535	2348	2181	2038	1913	1800	1723	1652	1586	1525	1470
2820	2611	2425	2265	2126	2000	1915	1835	1762	1695	1633

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	9.1	0:37	7.9	0:36	6.5	0:35	5.8	0:34	5.1	0:33
400	18.7	1:09	17.1	1:06	14.8	1:03	13.6	1:01	12.6	0:58
600	28.4	1:42	26.3	1:36	23.1	1:31	21.4	1:28	20.1	1:24
800	37.9	2:15	35.3	2:07	31.3	1:59	29.1	1:55	27.5	1:49
1000	47.3	2:48	44.3	2:38	39.4	2:27	36.8	2:22	34.8	2:15
1200	56.7	3:22	53.2	3:09	47.5	2:56	44.4	2:49	42.1	2:40
1400	66.1	3:55	62.1	3:41	55.5	3:24	51.9	3:17	49.3	3:06
1600	75.3	4:29	70.8	4:12	63.5	3:53	59.4	3:44	56.4	3:32
1800	84.5	5:04	79.5	4:44	71.4	4:22	66.8	4:12	63.5	3:58
2000	93.6	5:38	88.2	5:17	79.2	4:51	74.2	4:40	70.6	4:24

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)									
	400	450	500	550	600	650	700	750	800	
10	-1.4	-1.0	-0.7	-0.3	0.0	0.4	0.8	1.2	1.7	
20	-2.9	-2.2	-1.5	-0.7	0.0	0.9	1.8	2.8	3.8	
30	-4.5	-3.4	-2.3	-1.1	0.0	1.4	2.9	4.4	5.9	
40	-6.1	-4.6	-3.1	-1.5	0.0	1.9	3.9	6.0	8.1	
50	-7.6	-5.8	-3.9	-1.9	0.0	2.5	5.0	7.6	10.2	
60	-9.2	-7.0	-4.7	-2.3	0.0	3.0	6.1	9.2	12.3	
70	-10.7	-8.1	-5.5	-2.7	0.0	3.6	7.2	10.8	14.4	
80	-12.3	-9.3	-6.3	-3.1	0.0	4.2	8.3	12.4	16.5	
90	-13.8	-10.5	-7.1	-3.5	0.0	4.8	9.4	14.0	18.5	
100	-15.3	-11.6	-7.8	-3.9	0.0	5.4	10.6	15.7	20.6	
110	-16.9	-12.8	-8.6	-4.3	0.0	6.0	11.7	17.3	22.7	
120	-18.4	-13.9	-9.4	-4.7	0.0	6.6	12.9	19.0	24.8	

Long Range Cruise Enroute Fuel and Time - High Altitudes
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1032	976	925	879	838	800	767	736	708	682	657
1543	1460	1385	1317	1256	1200	1151	1106	1063	1024	989
2056	1946	1846	1756	1675	1600	1535	1475	1419	1367	1320
2571	2433	2308	2195	2094	2000	1920	1845	1775	1710	1651
3088	2922	2771	2635	2513	2400	2304	2214	2131	2053	1982
3606	3412	3235	3076	2932	2800	2688	2583	2486	2396	2313
4126	3904	3699	3517	3352	3200	3072	2953	2842	2739	2645
4649	4396	4165	3959	3772	3600	3456	3322	3197	3082	2976
5172	4890	4631	4400	4192	4000	3840	3691	3552	3424	3307
5697	5384	5098	4843	4612	4400	4224	4060	3908	3767	3637
6223	5880	5565	5285	5033	4800	4608	4429	4263	4109	3967
6751	6376	6034	5729	5453	5200	4992	4798	4617	4450	4297
7281	6874	6503	6172	5874	5600	5375	5166	4971	4791	4626
7812	7373	6973	6616	6295	6000	5759	5534	5324	5131	4954
8345	7874	7444	7061	6716	6400	6142	5901	5678	5471	5282
8880	8376	7915	7506	7138	6800	6525	6269	6030	5811	5610
9418	8880	8388	7952	7560	7200	6908	6636	6383	6150	5936
9959	9385	8863	8399	7982	7600	7291	7002	6735	6488	6262
10502	9893	9338	8846	8405	8000	7674	7369	7086	6826	6587

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
800	27.2	1:48	26.3	1:47	25.5	1:47	25.3	1:48	26.2	1:48
1200	41.3	2:39	40.1	2:36	39.0	2:36	38.4	2:37	39.5	2:38
1600	55.4	3:30	53.9	3:26	52.4	3:25	51.6	3:27	52.7	3:28
2000	69.6	4:21	67.7	4:16	65.8	4:15	64.8	4:16	66.0	4:18
2400	83.1	5:13	80.9	5:07	78.8	5:05	77.4	5:06	78.5	5:07
2800	96.7	6:06	94.1	5:58	91.7	5:55	90.1	5:55	90.9	5:57
3200	109.9	6:59	107.1	6:50	104.4	6:45	102.4	6:45	103.0	6:47
3600	122.9	7:54	119.8	7:42	116.9	7:36	114.6	7:35	114.9	7:37
4000	135.9	8:48	132.6	8:34	129.3	8:27	126.7	8:25	126.7	8:27
4400	148.4	9:43	144.8	9:28	141.3	9:19	138.4	9:16	138.1	9:17
4800	160.8	10:39	157.0	10:22	153.2	10:10	150.1	10:07	149.5	10:07
5200	173.0	11:36	168.9	11:17	165.0	11:03	161.5	10:58	160.6	10:57
5600	185.0	12:33	180.6	12:12	176.4	11:57	172.8	11:50	171.6	11:47
6000	197.0	13:30	192.3	13:08	187.9	12:50	184.0	12:41	182.5	12:38
6400	208.5	14:28	203.5	14:05	198.9	13:45	194.8	13:34	193.0	13:29
6800	220.0	15:27	214.8	15:02	209.9	14:41	205.5	14:27	203.5	14:21
7200	231.4	16:26	225.8	16:00	220.7	15:37	216.1	15:21	213.8	15:13
7600	242.5	17:26	236.6	16:58	231.2	16:33	226.4	16:16	223.9	16:05
8000	253.6	18:26	247.4	17:56	241.8	17:30	236.7	17:11	234.0	16:58

Long Range Cruise Enroute Fuel and Time - High Altitudes Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)								
	400	450	500	550	600	650	700	750	800
20	-3.7	-2.7	-1.7	-0.8	0.0	2.7	8.7	17.9	30.3
40	-8.1	-6.1	-4.1	-2.0	0.0	4.9	13.5	26.0	42.2
60	-12.3	-9.4	-6.4	-3.2	0.0	6.8	17.9	33.3	53.0
80	-16.5	-12.7	-8.7	-4.3	0.0	8.6	22.0	40.0	62.6
100	-20.6	-15.9	-10.9	-5.4	0.0	10.3	25.6	45.9	71.2
120	-24.5	-19.0	-13.1	-6.5	0.0	11.8	28.9	51.1	78.6
140	-28.4	-22.0	-15.1	-7.5	0.0	13.2	31.8	55.7	84.9
160	-32.2	-24.9	-17.1	-8.6	0.0	14.5	34.3	59.5	90.0
180	-35.9	-27.8	-19.1	-9.6	0.0	15.5	36.4	62.6	94.1
200	-39.5	-30.5	-21.0	-10.6	0.0	16.5	38.1	65.0	97.0
220	-43.0	-33.2	-22.8	-11.5	0.0	17.3	39.5	66.7	98.9
240	-46.4	-35.8	-24.6	-12.4	0.0	17.9	40.4	67.7	99.6
260	-49.7	-38.3	-26.3	-13.3	0.0	18.4	41.0	68.0	99.2
280	-52.9	-40.8	-27.9	-14.2	0.0	18.7	41.2	67.5	97.6
300	-56.0	-43.1	-29.5	-15.1	0.0	18.9	41.1	66.4	95.0
320	-59.0	-45.4	-31.0	-15.9	0.0	19.0	40.5	64.6	91.2
340	-61.9	-47.5	-32.4	-16.7	0.0	18.9	39.5	62.0	86.4

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 LB)											
	780	740	700	660	620	580	540	500	460	420	380	
43							188	94	35	6	0	
41						153	77	29	6	0	8	
39					117	58	22	4	0	8	23	
37			147	84	40	14	2	1	9	22	38	
35		101	56	25	7	0	2	10	23	37	52	
33	66	34	14	3	0	4	13	24	38	52	64	
31	18	6	0	1	7	16	27	39	52	63	72	
29	1	0	4	10	19	30	42	53	63	71	76	
27	2	7	15	24	34	44	55	64	71	76	77	
25	12	20	29	38	48	57	65	71	75	77	76	

The above wind factor table is for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. Read wind factors for present and new altitudes from table.
2. Determine difference (new altitude wind factor minus present altitude wind factor);
This difference may be negative or positive.
3. Break-even wind at new altitude is present altitude wind plus difference from step 2.

Descent at .84M/310/250

PRESSURE ALTITUDE (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	96	104	111	118	124	129	135	140	145	150
TIME (MINUTES)	20	21	22	23	24	24	25	26	26	27

**Holding
Flaps Up**

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
800	%N1	62.7	65.6	69.7	74.5	79.1	83.7	88.8			
	KIAS	273	275	276	301	314	318	312			
	FF/ENG	10540	10420	10330	10690	11040	11440	12000			
760	%N1	61.3	64.2	68.3	72.8	77.7	82.4	87.0			
	KIAS	266	268	269	285	306	309	312			
	FF/ENG	10010	9920	9800	9990	10430	10760	11180			
720	%N1	59.9	62.7	66.8	71.0	76.2	80.9	85.5			
	KIAS	259	260	261	271	297	300	305			
	FF/ENG	9490	9400	9280	9340	9830	10070	10400			
680	%N1	58.5	61.2	65.4	69.3	74.6	79.3	84.0			
	KIAS	252	253	254	256	286	291	296			
	FF/ENG	8980	8890	8760	8740	9200	9410	9720			
640	%N1	57.0	59.6	63.8	67.7	72.8	77.6	82.2			
	KIAS	245	245	246	248	267	282	286			
	FF/ENG	8470	8370	8250	8210	8480	8780	9070			
600	%N1	55.5	58.0	62.0	66.1	70.7	75.8	80.6	85.3		
	KIAS	236	237	238	239	251	273	276	279		
	FF/ENG	7980	7860	7740	7680	7800	8190	8420	8790		
560	%N1	53.9	56.4	60.2	64.4	68.7	74.0	78.7	83.5		
	KIAS	231	231	231	231	234	263	266	270		
	FF/ENG	7500	7370	7230	7170	7180	7600	7780	8020		
520	%N1	52.3	54.7	58.4	62.5	66.7	71.8	76.6	81.5		
	KIAS	225	225	225	225	225	243	256	259		
	FF/ENG	7060	6910	6740	6660	6650	6880	7150	7370		
480	%N1	50.7	53.0	56.6	60.5	64.7	69.3	74.5	79.3		
	KIAS	220	220	220	220	220	224	245	248		
	FF/ENG	6640	6470	6270	6190	6160	6210	6540	6720		
440	%N1	48.8	51.2	54.7	58.4	62.6	66.9	72.2	77.1	83.5	
	KIAS	213	213	213	213	213	213	232	237	240	
	FF/ENG	6240	6050	5840	5750	5680	5670	5920	6090	6440	
400	%N1	46.8	49.3	52.8	56.3	60.4	64.7	69.4	74.5	81.0	
	KIAS	207	207	207	207	207	207	209	225	228	
	FF/ENG	5850	5660	5430	5340	5250	5200	5230	5480	5760	
360	%N1	44.7	47.1	50.7	54.2	57.9	62.4	66.6	71.8	78.3	82.3
	KIAS	200	200	200	200	200	200	200	212	215	217
	FF/ENG	5590	5400	5170	5050	4940	4870	4840	4900	5110	5270

This table includes 5% additional fuel for holding in a racetrack pattern.

Holding Flaps 1

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
800	%N1	65.2	68.1	72.7	77.2	82.2
	KIAS	242	242	242	242	242
	FF/ENG	11530	11500	11450	11560	11820
760	%N1	63.7	66.5	70.9	75.4	80.5
	KIAS	242	242	242	242	242
	FF/ENG	10890	10840	10770	10840	11080
720	%N1	62.2	65.0	69.2	73.8	78.8
	KIAS	236	236	236	236	236
	FF/ENG	10290	10230	10160	10190	10400
680	%N1	60.6	63.5	67.6	72.2	77.1
	KIAS	228	228	228	228	228
	FF/ENG	9700	9640	9560	9570	9740
640	%N1	59.0	61.8	65.9	70.5	75.3
	KIAS	221	221	221	221	221
	FF/ENG	9130	9050	8960	8960	9090
600	%N1	57.3	60.0	64.1	68.4	73.2
	KIAS	216	216	216	216	216
	FF/ENG	8560	8480	8360	8360	8430
560	%N1	55.6	58.1	62.2	66.4	71.2
	KIAS	211	211	211	211	211
	FF/ENG	8010	7910	7790	7760	7810
520	%N1	53.9	56.3	60.2	64.3	68.9
	KIAS	205	205	205	205	205
	FF/ENG	7480	7350	7220	7180	7200
480	%N1	52.1	54.4	58.1	62.2	66.5
	KIAS	200	200	200	200	200
	FF/ENG	6990	6830	6670	6610	6600
440	%N1	50.1	52.4	56.0	59.9	64.1
	KIAS	193	193	193	193	193
	FF/ENG	6510	6330	6140	6050	6030
400	%N1	48.0	50.3	53.8	57.4	61.7
	KIAS	187	187	187	187	187
	FF/ENG	6050	5850	5650	5540	5490
360	%N1	45.5	48.1	51.5	54.9	59.0
	KIAS	180	180	180	180	180
	FF/ENG	5730	5530	5300	5180	5100

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight

Advisory Information

Chapter PI

Section 62

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 30

Dry Runway

	LANDING DISTANCE AND ADJUSTMENTS (FT)											
	REF DIST*	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°C		APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	500000 LB LANDING WT	PER 10000 LB ABOVE/ BELOW 500000 LB	PER 1000 FT ABOVE S.L.	HEAD WIND	TAIL WIND	DN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF30	ONE REV	NO REV
MAX MANUAL	3040	+70/-40	70	-130	450	40	-30	70	-70	240	70	140
MAX AUTO	4080	+70/-40	100	-170	620	0	0	100	-100	410	0	0
AUTOBRAKE 4	5300	+100/-60	140	-250	890	10	-10	140	-140	570	20	20
AUTOBRAKE 3	6260	+120/-80	170	-310	1100	10	-70	170	-170	590	40	50
AUTOBRAKE 2	7070	+130/-100	210	-350	1250	90	-160	190	-190	510	300	330
AUTOBRAKE 1	7800	+150/-120	250	-400	1460	230	-230	210	-210	510	820	1090

Good Reported Braking Action

MAX MANUAL	4250	+70/-60	110	-210	780	100	-90	110	-110	340	280	650
MAX AUTO	4560	+80/-70	110	-200	760	80	-50	110	-110	400	300	710
AUTOBRAKE 4	5310	+100/-80	140	-250	900	20	-10	140	-140	570	40	140
AUTOBRAKE 3	6260	+120/-100	170	-310	1100	10	-70	170	-170	590	40	50

Medium Reported Braking Action

MAX MANUAL	5640	+110/-100	170	-310	1240	250	-190	160	-160	420	750	1940
MAX AUTO	5870	+110/-90	170	-300	1200	240	-170	150	-150	450	740	1950
AUTOBRAKE 4	6000	+110/-100	170	-310	1230	190	-110	160	-160	570	670	1920
AUTOBRAKE 3	6520	+120/-110	190	-340	1320	130	-130	190	-180	590	380	1390

Poor Reported Braking Action

MAX MANUAL	7100	+150/-130	240	-440	1880	530	-340	210	-210	480	1550	4700
MAX AUTO	7410	+150/-130	240	-430	1840	530	-340	210	-210	470	1580	4790
AUTOBRAKE 4	7410	+150/-130	240	-430	1840	530	-310	210	-210	510	1580	4760
AUTOBRAKE 3	7520	+150/-130	240	-440	1880	440	-290	220	-220	590	1400	4620

*Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and 2 engine reverse thrust.

Max Manual braking data valid for auto speedbrakes. For manual speedbrakes, increase reference landing distance by 200 ft.

Autobrake data valid for both auto and manual speedbrakes.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 25

Dry Runway

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)											
	REF DIST*	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°C		APP SPD ADJ	REVERSE THRUST ADJ	
	500000 LB LANDING WT	PER 10000 LB ABOVE / BELOW 500000 LB	PER 1000 FT ABOVE S.L.	HEAD WIND	TAIL WIND	DN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF25	ONE REV	NO REV
MAX MANUAL	3190	+70/-40	70	-130	460	40	-30	70	-70	240	70	160
MAX AUTO	4380	+60/-40	110	-180	640	0	0	110	-110	430	0	0
AUTOBRAKE 4	5720	+80/-60	150	-260	920	10	-10	160	-160	600	20	20
AUTOBRAKE 3	6790	+100/-90	200	-320	1140	20	-90	190	-190	590	70	80
AUTOBRAKE 2	7620	+120/-120	230	-360	1300	120	-180	210	-210	520	410	450
AUTOBRAKE 1	8360	+150/-130	270	-420	1510	250	-250	220	-230	520	970	1340

Good Reported Braking Action

MAX MANUAL	4490	+70/-70	120	-210	790	110	-90	120	-120	340	310	720
MAX AUTO	4830	+70/-70	120	-210	790	90	-40	120	-120	430	320	780
AUTOBRAKE 4	5740	+80/-90	150	-260	940	20	-10	160	-160	600	40	150
AUTOBRAKE 3	6790	+100/-120	200	-320	1140	20	-90	190	-190	590	70	80

Medium Reported Braking Action

MAX MANUAL	5980	+100/-100	190	-320	1270	260	-200	170	-170	430	820	2160
MAX AUTO	6220	+100/-100	180	-310	1230	250	-170	160	-170	460	830	2170
AUTOBRAKE 4	6400	+100/-110	190	-330	1270	180	-110	180	-180	600	680	2090
AUTOBRAKE 3	7030	+110/-120	210	-360	1360	130	-150	200	-200	590	420	1500

Poor Reported Braking Action

MAX MANUAL	7530	+140/-140	260	-460	1920	550	-360	230	-230	490	1710	5230
MAX AUTO	7860	+140/-140	260	-440	1880	550	-350	220	-220	480	1740	5320
AUTOBRAKE 4	7860	+150/-140	260	-450	1890	550	-320	220	-220	540	1740	5300
AUTOBRAKE 3	8050	+140/-150	260	-460	1920	440	-310	240	-240	590	1480	5100

*Reference distance is for sea level, standard day, no wind or slope, VREF25 approach speed and 2 engine reverse thrust.

Max Manual braking data valid for auto speedbrakes. For manual speedbrakes, increase reference landing distance by 200 ft.

Autobrake data valid for both auto and manual speedbrakes.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 20

Dry Runway

	LANDING DISTANCE AND ADJUSTMENTS (FT)											
	REF DIST*	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°C		APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	500000 LB LANDING WT	PER 10000 LB ABOVE / BELOW 500000 LB	PER 1000 FT ABOVE S.L.	HEAD WIND	TAIL WIND	DN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF20	ONE REV	NO REV
MAX MANUAL	3450	+90/-40	80	-130	450	40	-40	80	-80	240	90	200
MAX AUTO	4840	+70/-70	120	-200	660	0	0	120	-130	460	0	0
AUTOBRAKE 4	6360	+90/-100	180	-280	940	10	-10	180	-180	640	20	20
AUTOBRAKE 3	7480	+120/-130	220	-340	1160	50	-100	210	-210	640	110	120
AUTOBRAKE 2	8090	+140/-150	270	-390	1320	150	-200	230	-230	580	540	570
AUTOBRAKE 1	8710	+170/-170	310	-440	1520	300	-310	260	-260	550	1240	1690

Good Reported Braking Action

MAX MANUAL	4920	+70/-80	140	-220	780	120	-100	120	-120	350	380	900
MAX AUTO	5080	+80/-80	140	-230	790	70	-50	130	-130	460	350	910
AUTOBRAKE 4	6370	+100/-100	180	-280	960	20	-20	180	-180	640	40	160
AUTOBRAKE 3	7480	+120/-130	220	-340	1160	50	-100	210	-210	640	110	120

Medium Reported Braking Action

MAX MANUAL	6590	+110/-110	210	-340	1240	270	-220	170	-180	440	990	2630
MAX AUTO	6590	+120/-110	210	-340	1220	270	-190	170	-170	480	980	2620
AUTOBRAKE 4	6880	+120/-120	210	-350	1270	180	-120	190	-190	640	760	2450
AUTOBRAKE 3	7720	+130/-140	240	-380	1370	150	-160	220	-220	640	460	1740

Poor Reported Braking Action

MAX MANUAL	8310	+160/-160	300	-490	1870	580	-410	230	-230	510	2020	6270
MAX AUTO	8310	+160/-160	290	-480	1860	580	-400	220	-220	510	2030	6320
AUTOBRAKE 4	8310	+160/-150	300	-480	1860	580	-350	230	-230	590	2030	6280
AUTOBRAKE 3	8570	+160/-160	300	-500	1900	480	-350	240	-240	640	1700	6020

*Reference distance is for sea level, standard day, no wind or slope, VREF20 approach speed and 2 engine reverse thrust.

Max Manual braking data valid for auto speedbrakes. For manual speedbrakes, increase reference landing distance by 230 ft.

Autobrake data valid for both auto and manual speedbrakes.

Actual (unfactored) distances are shown.

Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

**Non-Normal Configuration Landing Distance
Dry Runway**

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	500000 LB LDG WT	PER 10000 LB ABV/BLW 500000 LB	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	5980	100/-100	190	-320/1210	260/-200	90/-90	410	840	2200
ANTISKID (FLAPS 30)	VREF30	5640	110/-80	180	-310/1180	250/-190	80/-80	410	760	1980
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	3500	100/-50	90	-130/490	50/-40	40/-40	260	-	160
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	3060	80/-30	70	-120/430	40/-40	40/-40	240	-	130
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	3850	150/-40	110	-150/570	60/-50	70/-70	280	160	370
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	3500	110/-30	90	-130/500	40/-40	40/-40	260	100	220
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	3460	90/-50	80	-130/470	40/-40	40/-40	240	90	200
FLAPS PRIMARY FAIL	VREF20	3950	80/-50	90	-150/500	50/-50	50/-50	320	120	260
FLAP/SLAT CONTROL	VREF20	3460	90/-50	80	-130/470	40/-40	40/-40	240	90	200
FLIGHT CONTROL MODE	VREF20	4000	80/-50	100	-150/510	50/-50	50/-50	330	130	280
HYD PRESS SYS C	VREF20	3950	80/-50	90	-150/500	50/-50	50/-50	320	120	260
HYD PRESS SYS L+C	VREF30+20	4380	100/-40	110	-160/560	70/-60	60/-60	410	-	190
HYD PRESS SYS L+R	VREF30+20	4740	90/-40	120	-190/660	110/-100	70/-70	460	-	-
HYD PRESS SYS R+C	VREF30+20	5380	80/-50	150	-220/760	140/-120	80/-80	520	-	440
HYD PRESS SYS L (FLAPS 25)	VREF25	3440	70/-40	80	-140/470	50/-50	40/-40	290	-	110
HYD PRESS SYS L (FLAPS 30)	VREF30	3270	70/-30	70	-130/460	50/-40	40/-40	290	-	100
HYD PRESS SYS R (FLAPS 25)	VREF25	3790	50/-50	90	-160/550	70/-60	50/-50	330	-	170
HYD PRESS SYS R (FLAPS 30)	VREF30	3580	60/-40	90	-150/530	60/-60	50/-50	320	-	150
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	3970	130/-40	110	-150/560	60/-50	60/-60	280	150	340
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	3530	100/-30	80	-130/460	40/-40	40/-40	250	100	210
PRI FLIGHT COMPUTERS	VREF20	4000	80/-50	100	-150/510	50/-50	50/-50	330	130	280
SLATS DRIVE	VREF30+30	3800	110/-40	100	-140/520	50/-40	40/-40	260	110	250
STABILIZER	VREF30+20	3530	100/-30	80	-130/460	40/-40	40/-40	250	100	210

Actual (unfactored) distances are shown.
Includes distances from 50 ft above threshold (1000 ft air distance).
Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****Good Reported Braking Action**

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	500000 LB LDG WT	PER 10000 LB ABV/BLW 500000 LB	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	5980	100/-100	190	-320/1210	260/-200	90/-90	410	840	2200
ANTISKID (FLAPS 30)	VREF30	5640	110/-80	180	-310/1180	250/-190	80/-80	410	760	1980
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	5170	80/-80	150	-240/840	150/-120	80/-80	380	-	640
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	4430	80/-60	120	-210/780	130/-100	60/-60	360	-	500
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	5580	90/-70	160	-230/830	130/-110	90/-90	340	510	1240
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	5020	80/-60	140	-220/800	120/-110	70/-70	350	420	1000
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	4920	70/-80	140	-220/790	120/-100	70/-70	350	380	890
FLAPS PRIMARY FAIL	VREF20	5500	80/-90	160	-240/850	140/-120	80/-80	430	470	1130
FLAP/SLAT CONTROL	VREF20	4920	70/-80	140	-220/790	120/-100	70/-70	350	380	890
FLIGHT CONTROL MODE	VREF20	5590	80/-90	160	-240/860	150/-130	80/-80	450	490	1200
HYD PRESS SYS C	VREF20	5500	80/-90	160	-240/850	140/-120	80/-80	430	470	1130
HYD PRESS SYS L+C	VREF30+20	6460	110/-70	190	-290/1000	230/-190	100/-100	580	-	840
HYD PRESS SYS L+R	VREF30+20	6910	110/-70	200	-320/1110	320/-250	110/-110	650	-	-
HYD PRESS SYS R+C	VREF30+20	6550	110/-70	190	-290/1010	240/-190	100/-100	600	-	880
HYD PRESS SYS L (FLAPS 25)	VREF25	5110	70/-80	140	-240/870	160/-140	70/-70	430	-	530
HYD PRESS SYS L (FLAPS 30)	VREF30	4840	90/-60	130	-230/850	160/-130	70/-70	430	-	480
HYD PRESS SYS R (FLAPS 25)	VREF25	5110	70/-80	140	-240/870	160/-140	70/-70	430	-	530
HYD PRESS SYS R (FLAPS 30)	VREF30	4790	80/-60	130	-230/840	150/-130	70/-70	420	-	460
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	5690	90/-70	170	-240/840	140/-120	80/-80	350	500	1200
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	5020	80/-60	140	-220/800	120/-110	60/-60	350	390	930
PRI FLIGHT COMPUTERS	VREF20	5590	80/-90	160	-240/860	150/-130	80/-80	450	490	1200
SLATS DRIVE	VREF30+30	5400	90/-70	160	-230/830	130/-110	70/-70	360	440	1050
STABILIZER	VREF30+20	5020	80/-60	140	-220/800	120/-110	60/-60	350	390	930

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (1000 ft air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION

**Non-Normal Configuration Landing Distance
Medium Reported Braking Action**

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	500000 LB LDG WT	PER 10000 LB ABV/BLW 500000 LB	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	7490	140/-140	270	-450/1820	550/-360	110/-110	470	1730	5310
ANTISKID (FLAPS 30)	VREF30	7050	150/-110	240	-440/1780	530/-340	100/-100	460	1570	4780
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	7310	130/-130	230	-380/1410	400/-300	110/-110	510	-	1910
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	6160	120/-90	190	-340/1300	340/-250	90/-90	470	-	1460
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	7580	140/-110	260	-360/1320	300/-240	130/-130	440	1350	3810
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	6750	130/-100	220	-340/1270	290/-230	100/-100	450	1110	3040
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	6580	120/-110	220	-340/1260	290/-220	100/-100	430	990	2630
FLAPS PRIMARY FAIL	VREF20	7230	130/-130	240	-360/1330	330/-250	110/-110	520	1180	3230
FLAP/SLAT CONTROL	VREF20	6580	120/-110	220	-340/1260	290/-220	100/-100	430	990	2630
FLIGHT CONTROL MODE	VREF20	7380	130/-130	250	-370/1350	340/-260	110/-110	540	1250	3480
HYD PRESS SYS C	VREF20	7230	130/-130	240	-360/1330	330/-250	110/-110	520	1180	3230
HYD PRESS SYS L+C	VREF30+20	9090	170/-120	300	-460/1670	600/-430	140/-140	720	-	2530
HYD PRESS SYS L+R	VREF30+20	11120	180/-120	350	-590/2100	1160/-730	190/-190	910	-	-
HYD PRESS SYS R+C	VREF30+20	9200	170/-120	310	-460/1680	620/-440	140/-140	740	-	2630
HYD PRESS SYS L (FLAPS 25)	VREF25	7290	120/-120	240	-400/1490	460/-330	110/-110	560	-	1660
HYD PRESS SYS L (FLAPS 30)	VREF30	6880	130/-90	220	-390/1460	440/-310	110/-110	560	-	1510
HYD PRESS SYS R (FLAPS 25)	VREF25	7240	120/-120	230	-400/1490	450/-320	110/-110	550	-	1630
HYD PRESS SYS R (FLAPS 30)	VREF30	6720	130/-90	210	-380/1440	420/-300	100/-100	530	-	1410
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	7590	140/-110	260	-360/1330	310/-240	110/-120	440	1260	3430
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	6690	130/-100	220	-340/1270	290/-220	80/-80	430	1010	2680
PRI FLIGHT COMPUTERS	VREF20	7380	130/-130	250	-370/1350	340/-260	110/-110	540	1250	3480
SLATS DRIVE	VREF30+30	7190	130/-100	240	-350/1310	310/-240	90/-90	440	1110	2970
STABILIZER	VREF30+20	6690	130/-100	220	-340/1270	290/-220	80/-80	430	1010	2680

Actual (unfactored) distances are shown.
Includes distances from 50 ft above threshold (1000 ft air distance).
Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION**Non-Normal Configuration Landing Distance****Poor Reported Braking Action**

		LANDING DISTANCES AND ADJUSTMENTS (FT)								
		REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS	SLOPE ADJ PER 1%	TEMP ADJ PER 10°C	APP SPD ADJ	REVERSE THRUST ADJ	
EICAS MESSAGE	VREF	500000 LB LDG WT	PER 10000 LB ABV/BLW 500000 LB	PER 1000 FT ABV S.L.	HEAD/ TAIL WIND	DOWN/ UP HILL	ABV/ BLW ISA	PER 10 KTS ABV VREF	ONE REV	NO REV
ANTISKID (FLAPS 25)	VREF25	9650	210/-190	380	-690/3260	2660/-720	150/-150	530	4340	15000
ANTISKID (FLAPS 30)	VREF30	9090	220/-160	350	-670/3200	2580/-690	140/-140	510	4010	15000
ENG SHUTDOWN L, R (FLAPS 20)	VREF20	9740	190/-180	350	-570/2230	990/-590	160/-160	610	-	4850
ENG SHUTDOWN L, R (FLAPS 30)	VREF30	8140	170/-130	280	-520/2070	840/-490	130/-130	550	-	3690
FLAPS DRIVE (FLAPS ≤ 5)	VREF30+40	9580	200/-150	370	-500/1990	640/-430	170/-170	530	2770	9540
FLAPS DRIVE (5 < FLAPS < 20)	VREF30+20	8510	180/-140	320	-480/1920	620/-410	130/-130	520	2280	7500
FLAPS DRIVE (FLAPS ≥ 20)	VREF20	8270	160/-150	300	-470/1900	610/-400	130/-130	500	2020	6320
FLAPS PRIMARY FAIL	VREF20	8950	180/-170	330	-500/1980	670/-440	140/-140	580	2330	7610
FLAP/SLAT CONTROL	VREF20	8270	160/-150	300	-470/1900	610/-400	130/-130	500	2020	6320
FLIGHT CONTROL MODE	VREF20	9150	180/-170	340	-510/2000	700/-460	140/-140	610	2480	8260
HYD PRESS SYS C	VREF20	8950	180/-170	330	-500/1980	670/-440	140/-140	580	2330	7610
HYD PRESS SYS L+C	VREF30+20	12140	240/-180	450	-700/2730	1560/-850	200/-200	820	-	6360
HYD PRESS SYS L+R	VREF30+20	17790	270/-160	590	-1100/4220	5750/-1980	320/-320	1140	-	-
HYD PRESS SYS R+C	VREF30+20	12260	250/-190	460	-710/2750	1590/-870	200/-200	840	-	6540
HYD PRESS SYS L (FLAPS 25)	VREF25	9910	180/-170	360	-630/2520	1310/-690	160/-160	660	-	4300
HYD PRESS SYS L (FLAPS 30)	VREF30	9370	190/-140	330	-610/2470	1270/-660	150/-150	660	-	3950
HYD PRESS SYS R (FLAPS 25)	VREF25	9790	170/-170	350	-620/2500	1280/-670	160/-160	640	-	4150
HYD PRESS SYS R (FLAPS 30)	VREF30	9040	180/-130	320	-600/2420	1190/-620	140/-140	610	-	3570
PITCH UP AUTHORITY (FLAPS 5)	VREF30+40	9450	190/-150	360	-500/1980	640/-430	150/-150	500	2480	8010
PITCH UP AUTHORITY (FLAPS 20)	VREF30+20	8360	180/-130	300	-480/1900	610/-400	110/-110	500	2030	6340
PRI FLIGHT COMPUTERS	VREF20	9150	180/-170	340	-510/2000	700/-460	140/-140	610	2480	8260
SLATS DRIVE	VREF30+30	8960	190/-140	330	-490/1950	630/-420	120/-120	500	2210	6900
STABILIZER	VREF30+20	8360	180/-130	300	-480/1900	610/-400	110/-110	500	2030	6340

Actual (unfactored) distances are shown.

Includes distances from 50 ft above threshold (1000 ft air distance).

Assumes maximum manual braking and maximum available reverse thrust.

ADVISORY INFORMATION

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 LB)					
		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
54	129	672.3	628.0				
52	126	690.0	643.1				
50	122	707.8	659.3	605.6			
48	118	725.5	677.8	619.9			
46	115	743.7	696.5	635.4	585.0		
44	111	761.0	714.1	652.5	600.2		
42	108	777.3	732.3	671.6	614.6	563.6	
40	104	793.0	750.7	689.9	629.6	576.5	
38	100	809.0	769.5	707.1	644.2	589.2	523.7
36	97	823.4	785.6	722.9	658.1	600.0	534.2
34	93	834.9	801.0	739.6	671.9	609.6	544.6
32	90	835.0	816.7	753.4	684.7	618.5	554.2
30	86	835.0	830.3	765.2	699.0	627.8	562.5
28	82	835.0	830.6	775.5	709.9	638.0	570.7
26	79	835.0	830.8	787.4	718.4	648.3	578.8
24	75	835.0	831.0	787.5	725.5	659.0	587.6
22	72	835.0	831.2	787.7	732.4	666.4	596.9
20	68	835.0	831.5	787.8	732.6	671.0	604.8
18	64	835.0	831.6	788.0	732.8	675.5	610.3
16	61	835.0	831.8	788.2	732.9	675.6	614.2
14	57	835.0	831.9	788.4	733.1	675.8	617.6
12	54	835.0	832.1	788.5	733.3	675.9	617.8
10	50	835.0	832.1	788.7	733.4	675.9	617.9
8	46	835.0	832.2	788.9	733.6	676.0	617.9
6	43	835.0	832.3	788.9	733.7	676.0	617.8
4	40	835.0	832.4	781.7	706.6	645.9	570.9
2	36	835.0	832.4	781.9	706.7	646.0	570.9
0	32	835.0	832.5	781.9	706.8	646.1	571.0
-40	-40	835.0	832.7	781.9	706.8	646.1	571.1

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.

With engine bleed for packs off, increase weight by 2900 lb.

With engine and wing anti-ice on, decrease weight by 4800 lb.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 48400 lb.

ADVISORY INFORMATION**Landing Climb Limit Weight****Valid for approach with flaps 20 and landing with flaps 25**

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 LB)					
		AIRPORT PRESSURE ALTITUDE (FT)					
°C	°F	-2000	0	2000	4000	6000	8000
54	129	680.0	637.9				
52	126	695.9	653.6				
50	122	712.4	668.9	615.7			
48	118	729.4	684.9	630.1			
46	115	746.7	701.5	645.6	594.1		
44	111	763.5	718.1	662.4	609.4		
42	108	779.7	735.6	679.3	624.3	572.7	
40	104	795.5	753.2	695.5	639.7	586.1	
38	100	811.6	771.9	711.8	655.4	599.2	533.2
36	97	826.3	788.0	727.2	668.7	611.1	543.8
34	93	835.0	803.5	743.1	681.2	620.9	554.2
32	90	835.0	819.5	756.3	692.2	630.5	564.5
30	86	835.0	833.3	767.7	705.0	639.8	573.1
28	82	835.0	833.5	778.2	715.2	650.4	581.7
26	79	835.0	833.7	790.3	723.4	660.6	589.8
24	75	835.0	834.0	790.5	730.1	670.3	598.7
22	72	835.0	834.2	790.6	736.7	676.8	608.2
20	68	835.0	834.4	790.8	736.9	680.7	616.4
18	64	835.0	834.6	791.0	737.0	684.6	622.2
16	61	835.0	834.7	791.2	737.2	684.7	626.3
14	57	835.0	834.9	791.3	737.4	684.8	629.8
12	54	835.0	835.0	791.5	737.5	684.9	630.0
10	50	835.0	835.0	791.7	737.7	685.0	630.1
8	46	835.0	835.0	791.8	737.9	685.1	630.1
6	43	835.0	835.0	791.9	738.0	685.2	630.0
4	40	835.0	835.0	792.0	738.1	685.2	618.9
2	36	835.0	835.0	792.1	738.2	685.3	619.0
0	32	835.0	835.0	792.1	738.2	685.4	619.0
-40	-40	835.0	835.0	792.4	738.4	685.8	619.3

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.

With engine bleed for packs off, increase weight by 3200 lb.

With engine and wing anti-ice on, decrease weight by 4000 lb.

When operating in icing conditions during any part of the flight with forecast landing temperature below 10°C, decrease weight by 49000 lb.

ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Reference Brake Energy (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)																																			
		80						100						120						140						160						180					
WEIGHT (1000 LB)	OAT (°C)	PRESSURE ALTITUDE (1000 FT)																																			
		0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8												
780	0	21.8	23.8	26.1	32.5	35.8	39.7	45.4	50.5	56.5	59.5	66.5	74.6	74.6	83.6	94.0	90.2	101.1	113.5																		
	10	22.4	24.5	26.9	33.4	36.9	40.9	46.8	52.1	58.2	61.4	68.6	77.0	77.0	86.3	96.9	93.1	104.2	116.8																		
	15	22.8	24.9	27.4	34.0	37.6	41.7	47.7	53.1	59.3	62.5	69.9	78.4	78.3	87.8	98.6	94.7	106.0	118.7																		
	20	23.2	25.4	27.8	34.7	38.2	42.4	48.5	54.0	60.3	63.5	71.1	79.7	79.7	89.3	100.2	96.2	107.7	120.6																		
	30	23.8	26.0	28.5	35.5	39.2	43.5	49.8	55.4	62.0	65.3	73.0	81.9	81.9	91.7	102.9	98.9	110.6	123.7																		
740	0	23.9	26.1	28.7	35.9	39.7	44.1	50.6	56.3	63.0	66.4	74.4	83.5	83.4	93.5	105.0	100.8	112.8	126.0																		
	10	21.0	22.8	25.0	31.1	34.3	38.0	43.5	48.3	53.9	56.8	63.5	71.2	71.3	79.9	89.8	86.3	96.8	108.7																		
	15	21.5	23.5	25.7	32.0	35.3	39.1	44.8	49.8	55.6	58.6	65.5	73.5	73.6	82.5	92.6	89.1	99.8	111.9																		
	20	21.9	23.9	26.2	32.6	36.0	39.8	45.6	50.7	56.6	59.7	66.7	74.8	74.9	83.9	94.2	90.6	101.5	113.8																		
	30	22.3	24.3	26.7	33.2	36.6	40.5	46.4	51.6	57.6	60.7	67.9	76.1	76.2	85.3	95.8	92.1	103.1	115.6																		
700	0	22.8	24.9	27.3	34.0	37.5	41.6	47.6	53.0	59.2	62.4	69.7	78.2	78.3	87.7	98.4	94.7	105.9	118.6																		
	10	23.0	25.1	27.5	34.4	37.9	42.1	48.3	53.8	60.1	63.4	71.0	79.7	79.7	89.4	100.4	96.5	108.1	120.9																		
	15	20.1	21.9	23.9	29.8	32.8	36.2	41.5	46.1	51.4	54.2	60.5	67.8	68.0	76.2	85.6	82.4	92.4	103.8																		
	20	20.6	22.5	24.6	30.6	33.7	37.3	42.8	47.5	53.0	55.9	62.4	70.0	70.1	78.6	88.3	85.0	95.2	106.9																		
	30	21.0	22.9	25.1	31.2	34.3	38.0	43.6	48.4	53.9	56.9	63.5	71.2	71.4	80.0	89.8	86.4	96.9	108.7																		
620	0	21.4	23.3	25.5	31.8	35.0	38.7	44.3	49.2	54.9	57.9	64.6	72.4	72.6	81.3	91.3	87.9	98.5	110.4																		
	10	21.9	23.8	26.1	32.5	35.8	39.7	45.5	50.5	56.4	59.5	66.4	74.4	74.6	83.6	93.8	90.3	101.2	113.4																		
	20	22.0	24.0	26.3	32.9	36.2	40.2	46.1	51.3	57.3	60.5	67.6	75.8	76.0	85.2	95.7	92.1	103.2	115.6																		
	30	18.4	20.0	21.8	27.1	29.7	32.8	37.6	41.6	46.3	48.8	54.4	60.9	61.2	68.4	76.8	74.1	83.1	93.4																		
	40	18.9	20.5	22.4	27.9	30.6	33.8	38.7	42.9	47.7	50.4	56.1	62.8	63.1	70.6	79.3	76.5	85.7	96.3																		
540	0	19.3	20.9	22.8	28.4	31.2	34.4	39.4	43.6	48.6	51.3	57.1	63.9	64.2	71.9	80.7	77.8	87.2	97.9																		
	10	19.6	21.3	23.2	28.9	31.7	35.0	40.1	44.4	49.4	52.2	58.1	65.0	65.4	73.1	82.0	79.2	88.7	99.6																		
	20	20.0	21.7	23.8	29.6	32.5	35.9	41.1	45.6	50.7	53.6	59.7	66.8	67.1	75.1	84.3	81.4	91.2	102.3																		
	30	20.1	21.9	23.9	29.9	32.8	36.3	41.7	46.2	51.5	54.4	60.7	68.0	68.3	76.5	85.9	82.9	93.0	104.3																		
	40	16.8	18.1	19.8	24.4	26.7	29.4	33.6	37.1	41.2	43.4	48.3	53.9	54.2	60.5	67.8	65.5	73.4	82.5																		
460	0	17.2	18.6	20.3	25.1	27.5	30.3	34.6	38.2	42.4	44.8	49.8	55.5	55.9	62.4	69.9	67.6	75.7	85.1																		
	10	17.5	19.0	20.7	25.6	28.0	30.8	35.2	38.9	43.2	45.6	50.7	56.5	56.9	63.5	71.2	68.8	77.1	86.5																		
	20	17.8	19.3	21.0	26.0	28.5	31.4	35.9	39.6	44.0	46.4	51.5	57.5	57.9	64.6	72.4	70.0	78.4	88.0																		
	30	18.2	19.7	21.5	26.6	29.2	32.1	36.8	40.6	45.1	47.6	52.9	59.1	59.4	66.4	74.4	71.9	80.6	90.4																		
	40	18.3	19.8	21.6	26.9	29.4	32.5	37.2	41.1	45.7	48.3	53.7	60.1	60.4	67.6	75.8	73.3	82.1	92.2																		
380	0	15.2	16.4	17.7	21.8	23.8	26.1	29.6	32.6	36.0	37.9	42.0	46.7	47.0	52.3	58.5	56.6	63.3	70.9																		
	10	15.6	16.8	18.2	22.4	24.4	26.8	30.5	33.5	37.1	39.1	43.3	48.2	48.4	53.9	60.3	58.4	65.3	73.2																		
	15	15.9	17.1	18.6	22.8	24.9	27.3	31.0	34.2	37.8	39.8	44.1	49.1	49.3	54.9	61.4	59.4	66.4	74.5																		
	20	16.1	17.4	18.9	23.2	25.3	27.8	31.6	34.8	38.5	40.5	44.9	49.9	50.2	55.9	62.5	60.5	67.6	75.8																		
	30	16.5	17.8	19.3	23.7	25.9	28.4	32.4	35.6	39.4	41.5	46.0	51.3	51.5	57.4	64.2	62.1	69.4	77.8																		
	0	16.5	17.8	19.4	23.9	26.1	28.7	32.7	36.0	39.9	42.1	46.7	52.0	52.3	58.3	65.3	63.2	70.7	79.3																		
	10	13.6	14.6	15.8	19.2	20.8	22.7	25.6	28.1	30.9	32.4	35.7	39.6	39.6	43.9	48.9	47.3	52.7	58.9																		
	15	14.0	15.0	16.2	19.7	21.4	23.4	26.3	28.9	31.8	33.3	36.8	40.8	40.8	45.3	50.4	48.8	54.3	60.7																		
	20	14.2	15.3	16.5	20.0	21.8	23.8	26.8	29.4	32.4	33.9	37.4	41.5	41.6	46.1	51.4	49.7	55.3	61.8																		
	30	14.5	15.5	16.8	20.4	22.2	24.2	27.3	29.9	33.0	34.5	38.1	42.3	42.3	46.9	52.3	50.5	56.3	62.9																		
	0	14.8	15.9	17.2	20.8	22.7	24.8	28.0	30.6	33.8	35.4	39.1	43.3	43.4	48.1	53.6	51.9	57.8	64.6																		
	40	14.8	15.9	17.2	20.9	22.8	25.0	28.2	30.9	34.2	35.8	39.6	43.9	44.0	48.8	54.5	52.7	58.7	65.8																		

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.

If ground speed is used for brakes on speed, ignore wind and enter table with sea level, 15°C.

ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Event Adjusted Brake Energy (Millions of Foot Pounds)

No Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)											
EVENT		10	20	30	40	50	60	70	80	90	100	110	120
RTO MAX MAN		10	20	30	40	50	60	70	80	90	100	110	120
LANDING	MAX MAN	4.4	14.1	23.7	33.2	42.6	51.9	61.2	70.5	79.9	89.3	98.9	108.7
	MAX AUTO	4.4	13.1	21.7	30.2	38.7	47.3	56.0	65.0	74.3	83.9	94.0	104.6
	AUTOBRAKE 4	4.3	12.5	20.4	28.1	35.7	43.4	51.2	59.3	67.7	76.6	86.1	96.4
	AUTOBRAKE 3	4.2	11.9	19.2	26.3	33.3	40.3	47.4	54.8	62.6	70.8	79.7	89.3
	AUTOBRAKE 2	4.1	11.2	17.9	24.4	30.8	37.2	43.7	50.5	57.6	65.1	73.2	81.9
	AUTOBRAKE 1	4.0	10.3	16.3	22.1	27.8	33.4	39.1	45.1	51.3	58.0	65.1	72.9

2 Engine Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)											
EVENT		10	20	30	40	50	60	70	80	90	100	110	120
RTO MAX MAN		10	20	30	40	50	60	70	80	90	100	110	120
LANDING	MAX MAN	3.3	12.0	21.0	30.0	38.9	47.5	56.1	64.5	72.8	81.0	89.2	97.5
	MAX AUTO	2.0	8.7	15.5	22.3	29.3	36.4	43.8	51.5	59.6	68.3	77.5	87.4
	AUTOBRAKE 4	1.4	5.6	10.4	15.6	20.9	26.4	32.2	38.3	44.8	51.9	59.6	68.0
	AUTOBRAKE 3	0.9	3.2	6.4	10.3	14.3	18.5	23.0	27.9	33.2	39.0	45.4	52.4
	AUTOBRAKE 2	0.3	1.8	4.0	6.5	9.3	12.3	15.6	19.2	23.3	27.9	33.0	38.7
	AUTOBRAKE 1	0.2	1.2	2.6	4.3	6.1	8.1	10.3	12.8	15.6	18.8	22.3	26.4

Cooling Time (Minutes)

		EVENT ADJUSTED BRAKE ENERGY (MILLIONS OF FOOT POUNDS)									
		16 & BELOW	17	18	20	24	28	32	35	36 TO 44	45 & ABOVE
GEAR DOWN	NO SPECIAL	PROCEDURE REQUIRED	1	2	3	4	6	7	7	CAUTION	FUSE PLUG MELT ZONE
INFLIGHT											
GROUND			11	18	26	42	55	66	73		
BTMS	UP TO 2.4		2.4	2.6	2.9	3.4	4.0	4.5	4.9	5.0 TO 6.3	6.3 & ABOVE

Observe maximum quick turnaround limit.

Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.

Add 1.0 million foot pounds for each taxi mile.

For one brake deactivated, increase brake energy by 10 percent.

For two brakes deactivated, increase brake energy by 20 percent.

When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after one hour. If overheat occurs after takeoff, extend gear soon for at least 8 minutes.

When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not attempt to taxi for one hour. Tire, wheel and brake replacement may be required. If overheat occurs after takeoff, extend gear soon for at least 12 minutes.

Brake temperature monitor system (BTMS) indication on EICAS may be used 10 to 15 minutes after airplane has come to a complete stop, or inflight with gear retracted, to determine recommended cooling schedule. (When inflight with gear extended, the BTMS indications may vary between individual brakes, due to air-stream effects.)

Intentionally
Blank

Performance Inflight
Engine Inoperative

Chapter PI
Section 63

ENGINE INOP

Initial Max Continuous %N1
Based on .84M, engine bleed for one pack on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	97.4	97.0	96.7	96.3	95.9	95.9	95.6	95.3	95.0
15	98.2	97.8	97.3	97.0	96.6	96.3	96.0	95.7	95.4
10	99.2	98.9	98.3	97.7	97.2	97.0	96.6	96.3	96.0
5	100.2	100.1	99.7	98.8	98.1	97.8	97.4	97.1	96.8
0	99.3	100.9	101.0	99.9	99.3	98.8	98.3	97.9	97.6
-5	98.4	99.9	101.2	101.3	100.5	100.2	99.7	99.3	98.8
-10	97.4	99.0	100.3	101.6	101.3	101.3	100.7	100.3	100.0
-15	96.5	98.1	99.3	100.6	101.0	102.0	101.1	100.8	100.5
-20	95.6	97.1	98.3	99.6	100.1	101.0	100.1	99.8	99.5
-25	94.6	96.1	97.4	98.6	99.1	100.0	99.1	98.8	98.5
-30	93.7	95.2	96.4	97.6	98.1	99.0	98.1	97.8	97.5
-35	92.7	94.2	95.4	96.6	97.0	97.9	97.1	96.8	96.5
-40	91.7	93.2	94.4	95.6	96.0	96.9	96.1	95.8	95.5

ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
37000 FT to 27000 FT Pressure Altitudes

37000 FT PRESS ALT													TAT (°C)	
KLAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	
280	0.86	94.3	95.4	96.4	97.4	98.4	99.5	100.5	101.4	101.2	100.2	98.9	97.7	
240	0.74	96.1	97.2	98.3	99.3	100.4	101.4	102.1	101.9	100.9	99.5	98.1	97.1	
200	0.63	95.7	96.7	97.8	98.8	99.9	100.8	101.4	100.9	100.0	98.5	97.0	96.3	
35000 FT PRESS ALT													TAT (°C)	
KLAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	
280	0.82	94.6	95.6	96.6	97.7	98.7	99.7	100.7	101.7	101.4	100.4	99.2	98.1	
240	0.71	95.1	96.2	97.2	98.3	99.3	100.3	101.3	101.8	100.9	99.8	98.3	97.2	
200	0.60	94.8	95.8	96.9	97.9	98.9	99.9	100.9	101.0	100.2	98.8	97.1	96.1	
33000 FT PRESS ALT													TAT (°C)	
KLAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	
320	0.89	91.4	92.4	93.4	94.4	95.4	96.4	97.4	98.3	99.3	100.2	99.8	98.8	
280	0.79	95.0	96.0	97.1	98.1	99.2	100.2	101.2	102.2	102.4	101.0	100.0	98.7	
240	0.68	95.6	96.7	97.8	98.8	99.8	100.9	101.9	102.4	101.8	100.2	98.9	97.5	
200	0.58	95.9	97.0	98.0	99.1	100.1	101.1	101.6	101.6	101.0	99.3	97.9	96.4	
31000 FT PRESS ALT													TAT (°C)	
KLAS	M	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	
320	0.85	92.7	93.8	94.8	95.7	96.7	97.7	98.7	99.6	100.5	100.8	99.7	98.4	
280	0.76	96.3	97.4	98.4	99.5	100.5	101.5	102.5	103.5	102.0	100.6	99.1	98.0	
240	0.66	97.4	98.4	99.5	100.5	101.5	102.6	103.3	103.0	101.0	99.5	98.1	96.9	
200	0.55	97.6	98.7	99.7	100.8	101.8	102.6	102.8	102.0	100.7	98.7	97.2	96.1	
29000 FT PRESS ALT													TAT (°C)	
KLAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	
320	0.82	93.8	94.8	95.8	96.8	97.8	98.7	99.7	100.6	101.6	100.1	98.9	97.8	
280	0.73	96.6	97.6	98.6	99.6	100.6	101.6	102.6	102.5	101.0	99.5	98.1	97.1	
240	0.63	98.1	99.2	100.2	101.3	102.3	103.3	103.1	101.6	99.8	98.4	97.1	96.0	
200	0.53	98.6	99.7	100.7	101.7	102.7	103.2	102.7	101.2	99.4	97.7	96.3	96.2	
27000 FT PRESS ALT													TAT (°C)	
KLAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	
360	0.88	90.2	91.2	92.1	93.0	94.0	94.9	95.8	96.7	97.6	98.5	99.2	98.1	
320	0.79	93.4	94.4	95.3	96.3	97.3	98.2	99.2	100.1	101.1	100.6	99.2	98.1	
280	0.70	95.4	96.4	97.4	98.4	99.4	100.4	101.3	102.3	101.3	99.7	98.2	97.1	
240	0.60	97.2	98.2	99.2	100.3	101.3	102.3	103.0	102.0	99.9	98.5	97.2	96.2	
200	0.51	98.4	99.4	100.4	101.5	102.5	103.2	102.7	101.8	99.9	98.1	96.5	95.6	

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	37	35	33	31	29	27
ENGINE A/I ON	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
WING A/I ON - PACKS ON	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3
WING A/I ON - PACKS OFF	-0.6	-0.5	-0.5	-0.5	-0.5	-0.4

ENGINE INOP**Max Continuous %N1****Based on engine bleed for packs on or off and anti-ice off****25000 FT to 18000 FT Pressure Altitudes**

25000 FT PRESS ALT									TAT (°C)					
KLAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	
360	0.85	91.2	92.2	93.1	94.1	95.0	95.9	96.8	97.7	98.6	99.5	98.9	98.1	
320	0.76	93.9	94.8	95.8	96.8	97.7	98.7	99.6	100.5	101.1	99.6	98.5	97.6	
280	0.67	95.5	96.5	97.5	98.5	99.4	100.4	101.3	101.5	100.4	98.8	97.5	96.7	
240	0.58	97.4	98.5	99.5	100.5	101.5	102.4	102.3	100.9	99.3	97.8	96.7	95.9	
200	0.49	99.3	100.3	101.4	102.4	103.4	103.1	102.0	100.6	98.5	97.1	96.1	95.9	
24000 FT PRESS ALT									TAT (°C)					
KLAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	
360	0.83	91.3	92.3	93.2	94.2	95.1	96.0	96.9	97.8	98.7	99.6	99.4	98.4	
320	0.75	93.6	94.6	95.6	96.5	97.5	98.4	99.4	100.3	101.2	100.0	98.8	97.8	
280	0.66	95.4	96.4	97.4	98.3	99.3	100.3	101.2	101.8	100.7	99.1	97.8	96.9	
240	0.57	97.3	98.3	99.3	100.3	101.3	102.2	102.6	101.4	99.8	98.3	97.1	96.2	
200	0.48	98.8	99.9	100.9	101.9	102.9	103.4	102.3	101.0	98.9	97.4	96.3	95.6	
22000 FT PRESS ALT									TAT (°C)					
KLAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	
360	0.80	92.1	93.0	94.0	94.9	95.8	96.7	97.6	98.5	99.4	100.0	99.0	98.3	
320	0.72	94.3	95.3	96.3	97.2	98.1	99.1	100.0	100.9	100.7	99.3	98.2	97.5	
280	0.63	96.1	97.1	98.1	99.0	100.0	100.9	101.9	101.3	99.8	98.4	97.3	96.6	
240	0.55	97.7	98.7	99.7	100.7	101.7	102.7	102.3	100.9	99.3	97.7	96.8	96.1	
200	0.46	99.5	100.5	101.5	102.5	103.5	103.0	101.5	99.9	97.9	96.8	95.9	95.8	
20000 FT PRESS ALT									TAT (°C)					
KLAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	
360	0.77	93.7	94.6	95.6	96.5	97.4	98.4	99.3	100.2	101.1	102.0	101.3	100.1	
320	0.69	95.9	96.9	97.8	98.8	99.7	100.7	101.6	102.6	103.5	101.8	100.4	99.1	
280	0.61	97.7	98.7	99.6	100.6	101.6	102.6	103.5	104.3	102.8	100.9	99.4	98.3	
240	0.53	98.5	99.5	100.5	101.5	102.4	103.4	104.3	104.1	102.4	100.7	98.7	97.2	
200	0.44	98.0	99.0	99.9	100.9	101.9	102.9	103.8	102.6	100.5	98.0	96.2	95.3	
18000 FT PRESS ALT									TAT (°C)					
KLAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	
360	0.75	94.4	95.4	96.3	97.2	98.2	99.1	100.0	100.9	101.8	102.0	100.6	99.4	
320	0.67	96.7	97.7	98.6	99.6	100.5	101.4	102.4	103.3	102.9	101.2	99.7	98.6	
280	0.59	98.5	99.5	100.5	101.5	102.4	103.4	104.3	104.0	102.3	100.4	98.9	97.8	
240	0.51	99.6	100.6	101.6	102.6	103.6	104.5	104.9	103.9	101.9	100.0	98.4	97.2	
200	0.42	97.2	98.2	99.2	100.1	101.1	101.9	102.0	100.8	98.8	97.3	95.8	94.4	

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	25	24	22	20	18
ENGINE A/I ON	-0.2	-0.2	-0.2	-0.2	-0.2
WING A/I ON - PACKS ON	-0.3	-0.3	-0.3	-0.2	-0.3
WING A/I ON - PACKS OFF	-0.4	-0.4	-0.4	-0.3	-0.5

ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
16000 FT to 5000 FT Pressure Altitudes

16000 FT PRESS ALT													TAT (°C)	
KLAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	
360	0.72	94.8	95.8	96.7	97.6	98.6	99.5	100.4	101.3	102.2	103.1	101.7	100.2	
320	0.64	96.9	97.9	98.8	99.8	100.7	101.7	102.6	103.5	104.4	102.7	100.9	99.4	
280	0.57	98.7	99.7	100.7	101.6	102.6	103.5	104.5	105.4	104.1	102.2	100.3	98.8	
240	0.49	99.1	100.1	101.1	102.0	103.0	104.0	104.9	104.5	103.0	100.9	99.2	97.9	
200	0.41	96.2	97.2	98.1	99.1	100.0	100.9	101.5	101.3	99.8	98.3	97.0	95.4	
14000 FT PRESS ALT													TAT (°C)	
KLAS	M	-20	-15	-10	-5	0	5	10	15	20	25	30	35	
360	0.69	94.9	95.9	96.8	97.7	98.6	99.5	100.4	101.3	102.2	102.2	100.8	99.5	
320	0.62	97.1	98.1	99.0	99.9	100.9	101.8	102.7	103.6	103.4	101.5	100.0	98.9	
280	0.54	99.2	100.1	101.1	102.1	103.0	103.9	104.9	104.9	103.0	101.0	99.5	98.4	
240	0.47	97.3	98.2	99.2	100.1	101.1	102.0	102.8	102.5	100.6	99.0	97.8	96.7	
200	0.39	96.1	97.0	98.0	98.9	99.8	100.7	101.4	100.7	99.0	97.6	96.5	95.6	
12000 FT PRESS ALT													TAT (°C)	
KLAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40	
360	0.67	95.4	96.3	97.2	98.1	99.0	99.9	100.8	101.6	102.5	101.3	100.0	99.0	
320	0.60	97.3	98.2	99.2	100.1	101.0	101.9	102.8	103.7	102.3	100.6	99.4	98.4	
280	0.52	99.7	100.6	101.6	102.5	103.5	104.4	105.3	104.0	102.0	100.2	99.1	98.1	
240	0.45	96.5	97.4	98.3	99.3	100.2	101.1	101.4	100.6	99.2	98.0	96.9	96.0	
200	0.38	96.7	97.7	98.6	99.5	100.4	101.2	101.3	100.2	98.7	97.4	96.4	95.8	
10000 FT PRESS ALT													TAT (°C)	
KLAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40	
360	0.65	94.2	95.2	96.1	96.9	97.8	98.7	99.6	100.4	101.3	101.5	100.2	99.1	
320	0.58	96.1	97.1	98.0	98.9	99.8	100.7	101.6	102.4	102.6	101.0	99.7	98.6	
280	0.51	98.5	99.4	100.4	101.3	102.2	103.1	104.0	104.6	102.3	100.5	99.4	98.4	
240	0.43	95.6	96.6	97.5	98.4	99.3	100.2	101.0	101.1	100.3	99.1	97.8	96.9	
200	0.36	96.6	97.5	98.4	99.3	100.2	101.1	101.6	101.2	100.1	98.5	97.5	96.6	
5000 FT PRESS ALT													TAT (°C)	
KLAS	M	-10	-5	0	5	10	15	20	25	30	35	40	45	
360	0.59	92.6	93.5	94.3	95.2	96.0	96.9	97.7	98.5	99.4	100.2	99.3	98.5	
320	0.53	94.0	94.9	95.8	96.7	97.5	98.4	99.2	100.1	100.9	100.1	99.1	98.2	
280	0.46	95.0	95.9	96.8	97.6	98.5	99.4	100.2	101.1	100.9	99.8	98.8	97.8	
240	0.40	95.7	96.6	97.5	98.4	99.3	100.2	101.0	101.6	100.5	99.4	98.3	97.4	
200	0.33	97.0	97.9	98.8	99.7	100.6	101.5	102.4	101.7	100.3	99.1	98.1	97.3	

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	16	14	12	10	5
ENGINE A/I ON	-0.3	-0.2	-0.4	-0.5	-0.5
WING A/I ON - PACKS ON	-0.4	-0.5	-0.6	-0.7	-0.8
WING A/I ON - PACKS OFF	-0.6	-0.7	-0.8	-0.9	-1.1

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

Includes APU fuel burn

WEIGHT (1000 LB)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
780	758	298	18000	16800	15600
740	720	290	19300	18200	17000
700	682	283	20500	19600	18500
660	642	275	21700	20900	20000
620	601	267	23200	22200	21200
580	562	258	25000	24000	22800
540	524	249	27000	26100	24700
500	485	241	29100	28400	27000
460	448	231	30900	30500	29400
420	409	221	32600	32300	31700
380	369	211	34400	34300	34000

ENGINE INOP

MAX CONTINUOUS THRUST

**Driftdown/LRC Cruise Range Capability
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
134	126	118	111	105	100	95	90	86	82	79
269	251	236	222	210	200	190	181	173	165	159
403	377	354	334	316	300	285	272	260	248	238
536	502	472	445	421	400	380	362	346	332	318
670	627	589	556	526	500	475	453	433	415	398
803	752	707	667	632	600	571	544	520	498	478
936	877	824	778	737	700	666	635	607	582	558
1068	1001	942	889	842	800	761	726	695	665	639
1201	1126	1059	1000	947	900	856	817	782	749	719
1333	1250	1176	1111	1052	1000	952	908	869	833	799
1466	1374	1293	1222	1157	1100	1047	1000	956	916	880
1598	1499	1411	1332	1262	1200	1142	1091	1043	1000	960
1731	1623	1528	1443	1368	1300	1238	1182	1131	1084	1040
1863	1747	1645	1554	1473	1400	1333	1273	1218	1167	1121
1996	1872	1762	1665	1578	1500	1428	1364	1305	1251	1201
2129	1997	1880	1776	1683	1600	1524	1455	1392	1334	1281
2262	2121	1997	1887	1788	1700	1619	1546	1479	1418	1361
2395	2246	2115	1998	1894	1800	1714	1637	1566	1501	1441

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 LB)											TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 LB)											
	380	420	460	500	540	580	620	660	700	740	780	
100	2.4	2.6	2.9	3.1	3.3	3.5	3.7	3.9	4.0	4.2	4.2	0:16
200	5.4	6.0	6.5	7.1	7.4	7.8	8.3	8.7	9.0	9.5	9.8	0:31
300	8.7	9.5	10.4	11.2	11.8	12.5	13.2	13.9	14.5	15.4	15.9	0:46
400	11.9	13.1	14.2	15.4	16.3	17.2	18.2	19.2	20.1	21.2	22.1	1:01
500	14.9	16.4	17.8	19.3	20.5	21.7	23.0	24.2	25.3	26.8	28.0	1:16
600	17.9	19.6	21.3	23.1	24.6	26.1	27.5	29.0	30.4	32.2	33.7	1:31
700	20.8	22.8	24.8	26.9	28.6	30.4	32.1	33.8	35.4	37.5	39.3	1:46
800	23.7	26.0	28.3	30.6	32.5	34.6	36.5	38.5	40.4	42.7	44.9	2:01
900	26.6	29.2	31.7	34.3	36.5	38.8	41.0	43.2	45.4	48.0	50.5	2:15
1000	29.5	32.3	35.1	37.9	40.4	42.9	45.4	47.9	50.3	53.2	56.0	2:30
1100	32.3	35.4	38.4	41.5	44.3	47.1	49.8	52.5	55.2	58.3	61.4	2:44
1200	35.1	38.5	41.8	45.1	48.1	51.2	54.1	57.1	60.1	63.5	66.8	2:59
1300	37.9	41.5	45.1	48.7	51.9	55.2	58.5	61.7	64.9	68.6	72.2	3:14
1400	40.7	44.6	48.4	52.2	55.7	59.3	62.8	66.2	69.7	73.6	77.5	3:28
1500	43.4	47.6	51.6	55.7	59.5	63.3	67.0	70.7	74.5	78.6	82.8	3:43
1600	46.1	50.5	54.9	59.2	63.2	67.3	71.3	75.2	79.2	83.6	88.1	3:58
1700	48.8	53.5	58.1	62.7	66.9	71.2	75.5	79.7	83.9	88.6	93.3	4:13
1800	51.5	56.4	61.2	66.1	70.6	75.2	79.6	84.1	88.6	93.5	98.5	4:27

Includes APU fuel burn.

Driftdown at optimum driftdown speed and cruise at LRC speed.

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
780	15300	14000	12400
760	16000	14400	12900
740	16700	15200	13300
720	17500	16000	14200
700	18300	16800	15100
680	19100	17600	16000
660	20000	18500	16800
640	20500	19300	17700
620	21100	20100	18700
600	21700	20800	19700
580	22500	21400	20400
560	23400	22100	21100
540	24300	23100	21700
520	25400	24200	22600
500	26600	25300	23700
480	27900	26600	24900
460	29300	27900	26200
440	30400	29200	27600
420	31300	30400	29000
400	32200	31600	30400
380	33200	32700	31700
360	34200	33900	33000

With engine anti-ice on, no altitude capability adjustment is required.
With engine and wing anti-ice on, decrease altitude capability by 300 ft.

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
780	%N1	91.3	96.8								
	MACH	.602	.664								
	KIAS	334	337								
	FF/ENG	22536	24156								
740	%N1	90.4	95.1	97.9							
	MACH	.602	.660	.678							
	KIAS	334	335	332							
	FF/ENG	21826	22989	23330							
700	%N1	89.4	93.5	95.6	98.8						
	MACH	.599	.649	.665	.684						
	KIAS	333	329	325	322						
	FF/ENG	21042	21608	21727	22025						
660	%N1	87.7	91.9	93.6	96.1						
	MACH	.583	.637	.653	.670						
	KIAS	324	323	319	315						
	FF/ENG	19683	20284	20323	20423						
620	%N1	85.9	90.2	91.9	93.6	96.5					
	MACH	.567	.621	.641	.657	.675					
	KIAS	315	315	313	309	305					
	FF/ENG	18411	18905	19032	19011	19194					
580	%N1	84.1	88.4	90.1	91.8	93.7	96.8				
	MACH	.551	.602	.625	.644	.661	.680				
	KIAS	306	305	305	302	298	295				
	FF/ENG	17177	17504	17683	17733	17760	18050				
540	%N1	82.1	86.3	88.2	89.9	91.6	93.7	97.0			
	MACH	.534	.582	.605	.627	.646	.663	.683			
	KIAS	296	294	295	294	292	288	285			
	FF/ENG	15983	16124	16312	16429	16476	16562	16922			
500	%N1	80.1	84.1	86.0	87.8	89.5	91.2	93.5	97.0		
	MACH	.516	.563	.583	.606	.629	.648	.665	.686		
	KIAS	286	284	284	284	284	281	277	274		
	FF/ENG	14812	14796	14951	15098	15202	15263	15363	15748		
460	%N1	77.9	81.8	83.6	85.5	87.2	88.9	90.7	93.1	96.7	
	MACH	.498	.543	.563	.583	.607	.630	.649	.666	.688	
	KIAS	276	274	273	273	273	272	270	266	264	
	FF/ENG	13638	13500	13643	13767	13886	13996	14052	14137	14531	
420	%N1	75.5	79.3	81.2	82.9	84.8	86.5	88.2	90.0	92.4	96.1
	MACH	.480	.521	.540	.560	.581	.605	.628	.648	.666	.688
	KIAS	266	263	262	262	261	261	261	258	255	252
	FF/ENG	12483	12254	12367	12495	12575	12676	12787	12829	12899	13288
380	%N1	73.1	76.7	78.5	80.3	82.0	83.8	85.6	87.3	89.1	91.5
	MACH	.462	.500	.517	.536	.556	.578	.601	.625	.646	.664
	KIAS	255	252	251	250	249	249	249	249	247	243
	FF/ENG	11350	11040	11139	11257	11323	11376	11460	11565	11610	11661
340	%N1	70.3	73.9	75.7	77.4	79.1	80.8	82.5	84.3	86.1	88.0
	MACH	.443	.478	.494	.511	.530	.550	.571	.594	.620	.642
	KIAS	245	240	239	238	237	236	236	236	236	234
	FF/ENG	10261	9890	9952	10062	10110	10131	10176	10235	10339	10404

ENGINE INOP**MAX CONTINUOUS THRUST****Long Range Cruise Diversion Fuel and Time****Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
286	264	244	227	213	200	190	181	173	166	159
569	525	487	454	425	400	381	364	348	333	320
853	788	730	681	638	600	572	546	522	501	482
1138	1051	974	908	851	800	763	729	698	669	643
1424	1316	1219	1136	1064	1000	954	911	872	836	803
1711	1580	1464	1364	1278	1200	1144	1093	1046	1003	964
1999	1846	1709	1592	1491	1400	1335	1275	1220	1170	1124
2288	2111	1954	1820	1704	1600	1526	1457	1394	1337	1285
2578	2378	2201	2049	1918	1800	1717	1639	1568	1504	1445
2869	2646	2447	2278	2132	2000	1907	1821	1742	1670	1605

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	9.2	0:38	8.1	0:37	7.3	0:36	6.5	0:35	6.1	0:34
400	19.3	1:12	17.7	1:09	16.5	1:06	15.6	1:04	15.3	1:02
600	29.2	1:46	27.2	1:41	25.7	1:37	24.5	1:34	24.4	1:30
800	39.0	2:21	36.6	2:14	34.7	2:07	33.2	2:03	33.3	1:58
1000	48.7	2:56	45.9	2:47	43.7	2:38	41.9	2:33	42.1	2:26
1200	58.4	3:31	55.1	3:20	52.6	3:09	50.5	3:03	50.7	2:55
1400	67.9	4:06	64.2	3:53	61.4	3:41	59.0	3:33	59.2	3:24
1600	77.4	4:41	73.2	4:27	70.1	4:12	67.4	4:03	67.6	3:53
1800	86.8	5:17	82.1	5:01	78.6	4:44	75.6	4:33	75.8	4:22
2000	96.1	5:53	90.9	5:35	87.2	5:16	83.8	5:03	84.0	4:51

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)								
	400	450	500	550	600	650	700	750	800
10	-1.7	-1.3	-0.8	-0.4	0.0	0.8	1.8	2.9	4.2
20	-3.7	-2.7	-1.8	-0.9	0.0	1.8	3.9	6.3	9.0
30	-5.7	-4.2	-2.7	-1.4	0.0	2.8	6.0	9.6	13.7
40	-7.7	-5.7	-3.7	-1.9	0.0	3.8	8.0	12.8	18.1
50	-9.8	-7.2	-4.7	-2.4	0.0	4.7	10.0	15.9	22.4
60	-11.8	-8.7	-5.7	-2.8	0.0	5.6	11.9	18.9	26.6
70	-13.9	-10.2	-6.7	-3.3	0.0	6.5	13.7	21.8	30.6
80	-15.9	-11.7	-7.7	-3.8	0.0	7.3	15.5	24.5	34.5
90	-18.0	-13.2	-8.7	-4.3	0.0	8.1	17.2	27.2	38.1
100	-20.1	-14.8	-9.7	-4.8	0.0	8.9	18.8	29.7	41.7

Includes APU fuel burn.

ENGINE INOP
MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
800	%N1	81.3	84.8	89.5	94.9			
	KIAS	273	275	276	301			
	FF/ENG	20620	20800	21460	23060			
760	%N1	79.7	83.0	87.8	92.7			
	KIAS	266	268	269	285			
	FF/ENG	19500	19610	20160	21200			
720	%N1	78.2	81.2	86.1	90.8	99.6		
	KIAS	259	260	261	271	297		
	FF/ENG	18410	18460	18870	19520	22300		
680	%N1	76.5	79.4	84.3	88.9	96.1		
	KIAS	252	253	254	256	286		
	FF/ENG	17340	17340	17630	18000	20240		
640	%N1	74.7	77.7	82.3	87.1	92.7		
	KIAS	245	245	246	248	267		
	FF/ENG	16280	16250	16430	16710	18210		
600	%N1	72.9	75.8	80.2	85.1	90.3		
	KIAS	236	237	238	239	251		
	FF/ENG	15240	15180	15250	15440	16560		
560	%N1	70.9	73.8	78.1	83.0	88.0	96.0	
	KIAS	231	231	231	231	234	263	
	FF/ENG	14210	14140	14130	14260	15010	16930	
520	%N1	68.8	71.9	76.0	80.8	85.8	91.6	
	KIAS	225	225	225	225	225	243	
	FF/ENG	13210	13140	13070	13140	13740	14810	
480	%N1	66.7	69.6	73.8	78.3	83.5	88.4	98.4
	KIAS	220	220	220	220	220	224	245
	FF/ENG	12240	12170	12060	12090	12540	13170	15210
440	%N1	64.6	67.3	71.6	75.9	80.8	85.7	93.3
	KIAS	213	213	213	213	213	213	232
	FF/ENG	11280	11200	11070	11080	11390	11800	13060
400	%N1	62.4	65.0	69.1	73.4	78.1	83.2	88.3
	KIAS	207	207	207	207	207	207	209
	FF/ENG	10360	10250	10130	10120	10320	10640	11140
360	%N1	60.0	62.6	66.4	70.7	75.3	80.3	85.0
	KIAS	200	200	200	200	200	200	200
	FF/ENG	9480	9350	9220	9210	9310	9520	9830

This table includes 5% additional fuel for holding in a racetrack pattern.

ENGINE INOP**ADVISORY INFORMATION****Gear Down Landing Rate of Climb Available****Flaps 20**

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	430	320				
50	480	370	210			
48	530	420	270			
46	570	470	320	160		
44	620	530	370	210		
42	670	570	410	250	90	
40	710	620	460	290	120	
38	740	670	510	330	150	
36	740	710	540	370	180	-20
34	740	760	580	400	210	0
32	750	760	610	440	240	30
30	750	770	640	460	280	60
20	770	780	650	510	350	170
10	790	800	600	420	260	130
0	810	810	590	360	130	-110
-20	840	850	610	370	130	-110
-40	880	880	640	390	140	-120

Rate of climb capability shown is valid for 500000 lb, gear down at VREF20 + 5.

Decrease rate of climb 30 ft/min per 10000 lb greater than 500000 lb.

Increase rate of climb 40 ft/min per 10000 lb less than 500000 lb.

Flaps 30

TAT (°C)	RATE OF CLIMB (FT/MIN)					
	PRESSURE ALTITUDE (FT)					
	-2000	0	2000	4000	6000	8000
52	-140	-250				
50	-100	-210	-360			
48	-60	-160	-320			
46	-10	-120	-270	-420		
44	30	-70	-220	-380		
42	70	-30	-180	-340	-500	
40	100	20	-150	-310	-470	
38	140	60	-110	-280	-450	
36	140	100	-70	-250	-420	-620
34	140	130	-40	-210	-400	-600
32	140	150	-10	-180	-370	-580
30	140	150	10	-160	-340	-550
20	150	150	20	-120	-270	-460
10	160	160	0	-150	-300	-660
0	160	160	-50	-270	-500	-730
-20	170	170	-60	-280	-510	-750
-40	180	170	-60	-300	-530	-780

Rate of climb capability shown is valid for 500000 lb, gear down at VREF30 + 5.

Decrease rate of climb 30 ft/min per 10000 lb greater than 500000 lb.

Increase rate of climb 40 ft/min per 10000 lb less than 500000 lb.

Intentionally
Blank

Performance Inflight**Alternate Mode EEC****Chapter PI****Section 64****ALTERNATE MODE EEC****Alternate Mode EEC Max Takeoff %N1**

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (1000 FT)											
°C	°F	-2	-1	0	1	2	3	4	5	6	7	8	8.4
55	131	94.3	96.7	97.0	96.7	96.5	96.6	96.4	96.3	96.1	95.5	94.6	94.2
50	122	95.7	98.1	98.6	98.2	97.9	97.9	97.8	97.6	97.4	96.8	95.9	95.6
45	113	97.2	99.6	100.1	99.8	99.4	99.3	99.1	98.9	98.8	98.2	97.3	96.9
40	104	98.9	101.2	101.9	101.4	101.0	100.8	100.6	100.4	100.0	99.4	98.6	98.2
35	95	100.9	102.7	104.7	104.2	103.1	102.6	102.1	101.7	101.1	100.4	99.6	99.3
30	86	100.5	103.7	106.9	106.4	105.6	105.0	104.3	103.7	102.6	101.5	100.7	100.3
25	77	99.7	102.8	106.0	106.7	107.3	107.2	106.7	106.5	105.3	103.8	102.4	101.8
20	68	98.8	101.9	105.1	105.8	106.4	106.8	107.1	107.5	106.8	105.9	104.8	104.3
15	59	98.0	101.1	104.2	104.9	105.5	105.8	106.2	106.5	106.4	106.1	105.6	105.3
10	50	97.1	100.2	103.3	104.0	104.6	104.9	105.3	105.6	105.5	105.2	104.9	104.8
5	41	96.3	99.3	102.4	103.0	103.7	104.0	104.3	104.7	104.5	104.2	104.0	103.8
0	32	95.4	98.4	101.4	102.1	102.7	103.1	103.4	103.7	103.6	103.3	103.0	102.9
-10	14	93.6	96.6	99.6	100.2	100.8	101.2	101.5	101.8	101.7	101.4	101.1	101.0
-20	-4	91.8	94.7	97.7	98.3	98.9	99.2	99.5	99.9	99.7	99.5	99.2	99.0
-30	-22	90.0	92.8	95.7	96.3	96.9	97.2	97.5	97.9	97.7	97.5	97.2	97.1
-40	-40	88.1	90.9	93.7	94.3	94.9	95.2	95.5	95.8	95.7	95.4	95.2	95.0
-50	-58	86.2	88.9	91.7	92.3	92.9	93.1	93.4	93.8	93.6	93.4	93.1	93.0

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)											
	-2	-1	0	1	2	3	4	5	6	7	8	8.4
PACKS OFF	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3
WING ANTI-ICE ON	-0.2	-0.3	-0.4	-0.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4

Intentionally
Blank

Performance Inflight**Gear Down****Chapter PI****Section 65****GEAR DOWN****220 KIAS Max Climb %N1**

TAT (°C)	PRESSURE ALTITUDE (1000 FT)														
	0	5	10	12	14	16	18	20	22	24	26	28	30	32	34
55	88.2	88.3	91.4	91.1	92.1	91.3	94.0	95.2	95.4	98.1	99.9	101.1	102.4	102.9	103.4
50	89.5	88.8	90.7	90.4	91.4	92.1	93.3	94.5	94.7	97.3	99.2	100.3	101.6	102.1	102.6
45	90.5	90.1	90.0	89.7	90.7	91.4	92.6	93.8	93.9	96.6	98.4	99.6	100.8	101.3	101.8
40	91.6	91.2	91.2	89.7	89.9	90.7	91.9	93.0	93.2	95.8	97.6	98.8	100.0	100.5	101.0
35	92.6	92.3	92.2	92.1	90.6	89.9	91.1	92.3	92.5	95.0	96.8	98.0	99.2	99.7	100.2
30	93.0	93.2	93.2	93.0	92.2	91.2	90.9	91.5	91.7	94.3	96.0	97.2	98.4	98.9	99.4
25	92.2	94.2	94.1	94.0	93.7	92.8	92.1	92.0	91.1	93.5	95.2	96.4	97.6	98.0	98.5
20	91.4	94.2	95.1	95.0	94.9	94.4	93.4	93.0	92.8	93.6	94.4	95.6	96.8	97.2	97.7
15	90.7	93.4	96.7	96.4	96.3	96.1	94.8	94.1	94.5	94.8	95.2	95.3	96.0	96.4	96.9
10	89.9	92.6	96.3	97.9	98.1	98.1	96.8	95.5	96.5	96.2	96.4	96.4	96.6	96.1	96.0
5	89.1	91.7	95.4	97.1	98.9	100.3	99.0	97.9	98.2	97.8	97.8	97.9	97.9	97.3	96.8
0	88.3	90.9	94.6	96.2	98.0	100.1	100.8	100.3	100.1	99.7	99.4	99.4	99.5	98.6	98.1
-5	87.4	90.1	93.7	95.3	97.1	99.1	99.9	100.8	101.9	101.5	101.1	101.1	101.1	100.2	99.6
-10	86.6	89.2	92.8	94.4	96.1	98.2	98.9	99.8	101.4	102.8	102.6	102.6	103.0	101.6	100.8
-15	85.8	88.4	91.9	93.5	95.2	97.3	98.0	98.9	100.4	101.8	102.5	103.2	103.8	102.5	101.4
-20	85.0	87.5	91.1	92.6	94.3	96.3	97.0	97.9	99.4	100.8	101.5	102.2	103.3	102.4	101.3

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)							
	0	5	10	15	20	25	30	35
2 PACKS ON - 1 BLEED SOURCE	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4
1 PACK ON - 1 OR 2 BLEED SOURCES	-0.4	-0.5	-0.4	-0.3	-0.2	-0.3	-0.3	-0.4
ENGINE ANTI-ICE ON	-0.3	-0.5	-0.4	-0.3	-0.1	-0.2	-0.2	-0.2
ENGINE & WING ANTI-ICE ON*	-0.6	-0.8	-0.7	-0.5	-0.2	-0.3	-0.3	-0.4
ENGINE & WING ANTI-ICE ON**	-1.1	-0.9	-0.9	-0.6	-0.3	-0.4	-0.5	-0.5

*Packs on or off with 2 bleed sources.

**Packs off with 1 bleed source.

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
780	18600	16600	14200
760	19100	17200	14800
740	19700	17900	15500
720	20200	18500	16100
700	21000	19400	17100
680	21900	20400	18200
660	22900	21500	19400
640	23900	22500	20600
620	25000	23500	21900
600	25900	24600	23000
580	27000	25700	24200
560	28000	27000	25400
540	29100	28200	26700
520	30100	29500	28000
500	30900	30500	29300
480	31600	31300	30500
460	32400	32200	31500
440	33300	33100	32600
420	34100	33900	33600
400	34900	34800	34600
380	35800	35700	35600
360	36700	36600	36400

GEAR DOWN**Long Range Cruise Control**

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
800	%N1	84.9	89.2	91.3	93.9						
	MACH	.488	.535	.556	.578						
	KIAS	270	270	270	270						
	FF/ENG	16879	17230	17550	18041						
760	%N1	84.0	88.3	90.3	92.5						
	MACH	.488	.535	.556	.578						
	KIAS	270	270	270	270						
	FF/ENG	16350	16643	16893	17295						
720	%N1	83.2	87.5	89.4	91.4	94.2					
	MACH	.488	.535	.556	.578	.600					
	KIAS	270	270	270	270	270					
	FF/ENG	15899	16146	16324	16639	17073					
680	%N1	81.4	85.8	87.8	89.6	91.8					
	MACH	.475	.521	.542	.564	.587					
	KIAS	263	263	263	263	264					
	FF/ENG	14938	15104	15281	15498	15865					
640	%N1	79.5	83.9	86.0	87.8	89.7	92.1				
	MACH	.461	.506	.526	.548	.570	.594				
	KIAS	255	255	255	255	256	256				
	FF/ENG	13989	14087	14216	14393	14638	14997				
600	%N1	77.6	82.1	84.1	86.0	87.7	89.7	92.5			
	MACH	.447	.491	.511	.531	.553	.576	.600			
	KIAS	247	247	247	247	248	248	248			
	FF/ENG	13042	13113	13185	13337	13490	13756	14123			
560	%N1	75.5	80.0	82.0	84.0	85.8	87.6	89.6	92.7		
	MACH	.433	.475	.494	.514	.535	.557	.581	.606		
	KIAS	239	239	239	239	239	240	240	240		
	FF/ENG	12107	12162	12207	12291	12445	12584	12856	13237		
520	%N1	73.3	77.8	79.8	81.8	83.7	85.4	87.3	89.4	92.8	
	MACH	.418	.459	.477	.496	.516	.538	.560	.584	.610	
	KIAS	231	231	231	231	231	231	231	232	232	
	FF/ENG	11193	11213	11263	11306	11394	11539	11679	11939	12332	
480	%N1	71.1	75.5	77.4	79.4	81.3	83.2	85.0	86.8	89.1	92.8
	MACH	.402	.442	.459	.478	.497	.517	.539	.562	.587	.614
	KIAS	222	222	222	222	222	222	222	222	223	223
	FF/ENG	10294	10279	10324	10368	10407	10495	10627	10769	11006	11406
440	%N1	68.6	73.1	75.0	76.8	78.9	80.7	82.7	84.4	86.2	88.5
	MACH	.387	.425	.442	.460	.478	.498	.519	.540	.563	.588
	KIAS	213	213	213	213	213	213	213	213	213	214
	FF/ENG	9429	9422	9440	9486	9514	9547	9627	9739	9856	10065
400	%N1	66.5	71.0	72.8	74.7	76.7	78.7	80.4	82.3	84.0	85.9
	MACH	.375	.413	.429	.446	.465	.484	.504	.525	.548	.571
	KIAS	207	207	207	207	207	207	207	207	207	207
	FF/ENG	8736	8731	8729	8756	8786	8810	8845	8930	9028	9136
360	%N1	64.3	68.7	70.5	72.3	74.4	76.4	78.2	79.9	81.8	83.6
	MACH	.363	.399	.415	.432	.450	.468	.488	.508	.530	.553
	KIAS	200	200	200	200	200	200	200	200	200	200
	FF/ENG	8041	8029	8026	8031	8049	8072	8095	8137	8220	8303

GEAR DOWN

**Long Range Cruise Enroute Fuel and Time
Ground to Air Miles Conversion**

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
316	284	257	235	216	200	189	180	171	162	155
634	570	515	470	433	400	379	359	341	326	312
956	859	774	706	650	600	568	539	512	489	468
1282	1149	1035	943	867	800	757	718	683	651	623
1610	1442	1297	1180	1084	1000	947	898	853	813	778
1942	1737	1560	1419	1302	1200	1136	1077	1024	976	933
2276	2034	1825	1658	1520	1400	1325	1256	1193	1137	1087
2614	2333	2091	1898	1739	1600	1514	1434	1362	1298	1241
2954	2634	2358	2138	1958	1800	1702	1613	1531	1459	1394
3297	2936	2626	2379	2176	2000	1891	1791	1701	1619	1547
3642	3240	2894	2620	2396	2200	2080	1969	1869	1780	1700
3991	3546	3164	2862	2615	2400	2268	2147	2037	1939	1852
4342	3853	3435	3104	2835	2600	2456	2324	2205	2098	2004
4697	4164	3707	3347	3055	2800	2644	2502	2373	2258	2156
5054	4476	3981	3591	3275	3000	2832	2679	2541	2416	2307
5414	4789	4255	3836	3495	3200	3020	2856	2708	2575	2458
5778	5105	4531	4081	3716	3400	3208	3033	2875	2734	2609
6146	5424	4808	4326	3937	3600	3396	3210	3041	2891	2759
6516	5744	5086	4572	4159	3800	3584	3386	3208	3049	2909
6889	6066	5365	4819	4380	4000	3772	3564	3375	3207	3059

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	15.5	0:49	14.1	0:47	12.4	0:44	11.4	0:42	10.6	0:40
400	31.3	1:36	29.1	1:31	26.2	1:24	24.6	1:20	23.3	1:15
600	47.2	2:24	44.0	2:16	40.0	2:04	37.8	1:57	36.1	1:51
800	62.4	3:12	58.4	3:02	53.3	2:46	50.5	2:36	48.3	2:27
1000	77.7	4:01	72.9	3:47	66.7	3:27	63.2	3:15	60.5	3:03
1200	92.4	4:51	86.8	4:34	79.6	4:10	75.4	3:55	72.2	3:40
1400	107.2	5:41	100.8	5:21	92.5	4:52	87.7	4:34	84.0	4:17
1600	121.4	6:32	114.3	6:08	105.0	5:35	99.5	5:14	95.4	4:55
1800	135.6	7:23	127.8	6:56	117.5	6:18	111.4	5:55	106.8	5:32
2000	149.4	8:15	140.8	7:45	129.6	7:02	122.9	6:36	117.8	6:10
2200	163.1	9:07	153.9	8:34	141.7	7:46	134.4	7:17	128.8	6:49
2400	176.4	10:01	166.5	9:23	153.4	8:31	145.6	7:58	139.5	7:28
2600	189.6	10:54	179.1	10:13	165.0	9:16	156.7	8:40	150.1	8:07
2800	202.5	11:49	191.2	11:04	176.4	10:02	167.5	9:23	160.4	8:46
3000	215.3	12:44	203.4	11:55	187.7	10:47	178.3	10:05	170.7	9:26
3200	227.7	13:40	215.1	12:47	198.7	11:34	188.7	10:49	180.7	10:06
3400	240.1	14:36	226.9	13:39	209.6	12:21	199.2	11:32	190.7	10:46
3600	252.1	15:33	238.3	14:32	220.3	13:08	209.3	12:16	200.3	11:27
3800	264.1	16:30	249.6	15:26	230.9	13:56	219.4	13:00	210.0	12:08
4000	275.9	17:28	260.7	16:20	241.3	14:44	229.3	13:45	219.4	12:50

GEAR DOWN

Long Range Cruise Enroute Fuel and Time
Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)							
	350	400	450	500	550	600	650	700
20	-2.9	-2.0	-1.1	0.0	1.7	4.0	6.6	9.5
40	-6.3	-4.3	-2.2	0.0	3.2	7.4	12.3	18.0
60	-9.7	-6.5	-3.3	0.0	4.7	10.7	17.8	25.9
80	-12.9	-8.7	-4.4	0.0	6.2	13.9	22.9	33.3
100	-16.1	-10.8	-5.5	0.0	7.6	16.8	27.7	40.2
120	-19.2	-12.9	-6.5	0.0	8.9	19.7	32.2	46.5
140	-22.2	-15.0	-7.6	0.0	10.2	22.3	36.3	52.3
160	-25.2	-17.0	-8.6	0.0	11.5	24.8	40.2	57.6
180	-28.0	-19.0	-9.6	0.0	12.7	27.2	43.7	62.3
200	-30.8	-20.9	-10.6	0.0	13.8	29.4	46.9	66.5
220	-33.5	-22.8	-11.6	0.0	14.9	31.5	49.8	70.1
240	-36.2	-24.7	-12.6	0.0	16.0	33.4	52.3	73.3
260	-38.7	-26.5	-13.6	0.0	17.0	35.1	54.5	75.8
280	-41.2	-28.2	-14.5	0.0	17.9	36.7	56.4	77.9

Descent at VREF30+80

PRESSURE ALTITUDE (1000 FT)	17	19	21	23	25	27	29	31	33	35
DISTANCE (NM)	35	39	43	48	52	56	60	64	69	73
TIME (MINUTES)	11	12	12	13	14	15	15	16	17	17

GEAR DOWN

**Holding
Flaps Up**

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
800	%N1	76.4						
	KIAS	262						
	FF/ENG	17280						
760	%N1	75.4	78.5					
	KIAS	262	262					
	FF/ENG	16690	16710					
720	%N1	73.9	76.9					
	KIAS	256	256					
	FF/ENG	15790	15760					
680	%N1	72.1	75.1	79.6				
	KIAS	248	248	248				
	FF/ENG	14820	14790	14740				
640	%N1	70.2	73.3	77.7				
	KIAS	241	241	241				
	FF/ENG	13860	13840	13780				
600	%N1	68.5	71.7	76.1				
	KIAS	236	236	236				
	FF/ENG	13050	13040	12960				
560	%N1	66.9	69.9	74.3	78.9			
	KIAS	231	231	231	231			
	FF/ENG	12270	12260	12180	12240			
520	%N1	65.3	68.1	72.5	77.1	81.9		
	KIAS	225	225	225	225	225		
	FF/ENG	11520	11490	11400	11430	11550		
480	%N1	63.6	66.3	70.7	75.2	80.0		
	KIAS	220	220	220	220	220		
	FF/ENG	10800	10750	10660	10660	10770		
440	%N1	61.7	64.5	68.6	73.1	77.8	82.7	
	KIAS	213	213	213	213	213	213	
	FF/ENG	10080	10000	9900	9890	9980	10110	
400	%N1	59.8	62.5	66.5	71.0	75.6	80.4	85.0
	KIAS	207	207	207	207	207	207	207
	FF/ENG	9380	9290	9170	9170	9210	9290	9520
360	%N1	57.7	60.4	64.3	68.7	73.3	78.2	82.7
	KIAS	200	200	200	200	200	200	200
	FF/ENG	8670	8580	8440	8430	8440	8500	8680

This table includes 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN

**Holding
Flaps 1**

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
800	%N1	76.0	79.1	84.0	88.5	94.6
	KIAS	242	242	242	242	242
	FF/ENG	16960	17050	17030	17300	18200
760	%N1	74.9	78.0	82.7	87.3	92.6
	KIAS	242	242	242	242	242
	FF/ENG	16320	16370	16340	16570	17270
720	%N1	73.3	76.4	80.9	85.7	90.6
	KIAS	236	236	236	236	236
	FF/ENG	15370	15390	15380	15540	16070
680	%N1	71.5	74.5	78.9	83.9	88.7
	KIAS	228	228	228	228	228
	FF/ENG	14380	14390	14380	14500	14850
640	%N1	69.4	72.6	77.0	81.9	86.7
	KIAS	221	221	221	221	221
	FF/ENG	13410	13410	13390	13510	13770
600	%N1	67.6	70.8	75.2	79.9	84.9
	KIAS	216	216	216	216	216
	FF/ENG	12590	12580	12530	12660	12860
560	%N1	65.9	68.9	73.3	77.9	83.0
	KIAS	211	211	211	211	211
	FF/ENG	11790	11760	11700	11810	11950
520	%N1	64.1	66.9	71.3	75.8	81.0
	KIAS	205	205	205	205	205
	FF/ENG	11000	10950	10880	10950	11070
480	%N1	62.2	64.9	69.3	73.8	78.7
	KIAS	200	200	200	200	200
	FF/ENG	10250	10170	10090	10130	10240
440	%N1	60.1	62.8	66.9	71.4	76.2
	KIAS	193	193	193	193	193
	FF/ENG	9480	9380	9290	9300	9400
400	%N1	57.9	60.7	64.6	69.1	73.7
	KIAS	187	187	187	187	187
	FF/ENG	8740	8640	8520	8500	8570
360	%N1	55.6	58.2	62.2	66.4	71.0
	KIAS	180	180	180	180	180
	FF/ENG	8010	7900	7760	7710	7760

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight

Gear Down, Engine INOP

Chapter PI

Section 66

GEAR DOWN**ENGINE INOP****MAX CONTINUOUS THRUST****Driftdown Speed/Level Off Altitude****100 ft/min residual rate of climb****Includes APU fuel burn**

WEIGHT (1000 LB)		VREF30 + 80 DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
700	674	253	5200	4000	1700
660	635	246	7100	6200	4600
620	596	239	9100	8400	7200
580	557	232	10900	10200	9100
540	519	227	12700	12100	10900
500	480	222	14500	14000	12900
460	442	216	16500	15900	15000
420	404	210	18600	18200	17000
380	366	203	20800	20500	19700

Long Range Cruise Altitude Capability**100 ft/min residual rate of climb**

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
740	800		
720	2200		
700	3600	1100	
680	4600	2700	
660	5600	4200	1400
640	6600	5400	3200
620	7600	6700	4800
600	8700	7900	6300
580	9700	9000	7900
560	10700	10100	9000
540	11700	11000	9900
520	12700	12000	10900
500	13600	13000	11800
480	14500	14000	12900
460	15500	15100	14000
440	16600	16000	15100
420	17700	17000	16100
400	18800	18400	17200
380	20000	19800	18700
360	21200	20800	20100

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)							
		5	7	9	11	13	15	17	19
680	%N1	97.1							
	MACH	.418							
	KIAS	253							
	FF/ENG	29597							
640	%N1	94.7	97.1						
	MACH	.407	.421						
	KIAS	246	246						
	FF/ENG	27548	27915						
600	%N1	92.6	94.4	97.1					
	MACH	.395	.409	.423					
	KIAS	239	239	238					
	FF/ENG	25711	25775	26281					
560	%N1	90.5	92.1	94.1	97.1				
	MACH	.383	.396	.410	.425				
	KIAS	232	231	231	231				
	FF/ENG	23975	23881	24040	24623				
520	%N1	88.5	90.1	91.9	94.1	97.5			
	MACH	.372	.386	.400	.415	.431			
	KIAS	225	225	225	225	225			
	FF/ENG	22233	22269	22345	22621	23249			
480	%N1	86.4	88.2	89.8	91.7	94.1	97.9		
	MACH	.363	.376	.391	.405	.421	.437		
	KIAS	220	220	220	220	220	220		
	FF/ENG	20677	20727	20792	20944	21208	21887		
440	%N1	84.0	85.9	87.7	89.4	91.3	93.8	97.9	
	MACH	.353	.366	.380	.394	.409	.425	.442	
	KIAS	213	213	213	213	213	213	213	
	FF/ENG	19092	19110	19166	19293	19457	19720	20473	
400	%N1	81.5	83.5	85.3	87.2	89.0	90.9	93.5	97.8
	MACH	.342	.355	.368	.382	.397	.413	.429	.446
	KIAS	207	207	207	207	207	207	207	207
	FF/ENG	17577	17577	17585	17695	17852	18003	18297	19100
360	%N1	78.9	80.7	82.7	84.6	86.5	88.3	90.2	92.9
	MACH	.331	.343	.356	.370	.384	.399	.415	.432
	KIAS	200	200	200	200	200	200	200	200
	FF/ENG	16044	16055	16035	16082	16230	16375	16525	16831

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
165	145	129	117	108	100	93	87	81	77	73
332	295	263	238	218	200	187	175	165	156	148
500	444	396	358	327	300	281	263	247	234	222
669	593	528	477	436	400	374	350	329	311	295
839	743	662	597	545	500	467	438	411	388	368
1009	894	795	718	655	600	561	525	494	466	442
1180	1044	928	838	764	700	654	612	575	543	515
1351	1196	1063	958	874	800	747	700	657	620	588
1523	1347	1197	1079	983	900	840	787	739	697	661
1696	1499	1331	1199	1093	1000	933	874	820	773	733

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	6		8		10		12		14	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
100	8.6	0:27	8.1	0:27	7.6	0:26	7.2	0:26	6.9	0:25
200	17.4	0:52	16.7	0:51	16.0	0:50	15.4	0:49	15.0	0:47
300	26.2	1:18	25.2	1:15	24.3	1:13	23.6	1:11	23.1	1:10
400	34.9	1:43	33.7	1:40	32.6	1:37	31.7	1:35	31.1	1:32
500	43.4	2:08	42.0	2:05	40.8	2:01	39.7	1:58	39.0	1:54
600	52.0	2:34	50.3	2:29	48.8	2:25	47.6	2:21	46.8	2:17
700	60.4	3:00	58.5	2:54	56.9	2:49	55.4	2:45	54.5	2:40
800	68.7	3:25	66.6	3:20	64.8	3:14	63.2	3:08	62.1	3:03
900	76.9	3:51	74.7	3:45	72.6	3:38	70.9	3:32	69.6	3:26
1000	85.1	4:18	82.6	4:10	80.4	4:03	78.5	3:56	77.0	3:49

GEAR DOWN

ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)							
	350	400	450	500	550	600	650	700
15	-2.5	-1.7	-0.8	0.0	1.6	3.3	5.2	7.3
20	-3.4	-2.3	-1.1	0.0	2.1	4.4	7.0	9.9
25	-4.3	-2.8	-1.4	0.0	2.6	5.5	8.8	12.5
30	-5.2	-3.4	-1.7	0.0	3.0	6.5	10.5	14.9
35	-6.0	-4.0	-2.0	0.0	3.5	7.6	12.2	17.4
40	-6.9	-4.6	-2.3	0.0	3.9	8.5	13.8	19.7
45	-7.8	-5.2	-2.6	0.0	4.4	9.5	15.4	22.0
50	-8.7	-5.8	-2.9	0.0	4.8	10.4	16.9	24.3
55	-9.6	-6.4	-3.2	0.0	5.2	11.3	18.4	26.5
60	-10.5	-7.0	-3.5	0.0	5.6	12.2	19.9	28.6
65	-11.4	-7.6	-3.8	0.0	6.0	13.1	21.3	30.7
70	-12.3	-8.2	-4.0	0.0	6.3	13.9	22.7	32.7
75	-13.1	-8.7	-4.3	0.0	6.7	14.7	24.0	34.6
80	-14.0	-9.3	-4.6	0.0	7.0	15.4	25.3	36.5
85	-14.9	-9.9	-4.9	0.0	7.3	16.1	26.5	38.4
90	-15.8	-10.5	-5.2	0.0	7.6	16.8	27.7	40.1

Includes APU fuel burn.

GEAR DOWN
ENGINE INOP
MAX CONTINUOUS THRUST

**Holding
Flaps Up**

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)			
		1500	5000	10000	15000
760	%N1	96.6			
	KIAS	262			
	FF/ENG	34160			
720	%N1	94.7			
	KIAS	256			
	FF/ENG	32150			
680	%N1	92.8	96.4		
	KIAS	248	248		
	FF/ENG	30210	30360		
640	%N1	90.8	94.0		
	KIAS	241	241		
	FF/ENG	28280	28220		
600	%N1	89.1	92.1	98.5	
	KIAS	236	236	236	
	FF/ENG	26550	26560	27770	
560	%N1	87.2	90.3	95.3	
	KIAS	231	231	231	
	FF/ENG	24850	25010	25470	
520	%N1	85.2	88.5	92.8	
	KIAS	225	225	225	
	FF/ENG	23170	23340	23590	
480	%N1	83.0	86.4	90.7	97.9
	KIAS	220	220	220	220
	FF/ENG	21570	21710	21890	22980
440	%N1	80.7	84.0	88.5	93.8
	KIAS	213	213	213	213
	FF/ENG	19930	20050	20190	20710
400	%N1	78.4	81.5	86.3	90.9
	KIAS	207	207	207	207
	FF/ENG	18360	18460	18510	18900
360	%N1	76.0	78.9	83.6	88.3
	KIAS	200	200	200	200
	FF/ENG	16800	16850	16850	17190

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight**Text****Chapter PI****Section 67**

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer. In addition, sufficient inflight data is provided to complete a flight with the FMC inoperative. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General**FMC Takeoff Speeds**

FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Clearway and Stopway V1 Adjustments

Takeoff speed corrections are to be applied to V1 when using takeoff weights based on the use of clearway and stopway.

Adjust V1 by the amount shown in the table. The adjusted V1 must not exceed VR. If V1 is greater than VR, VR may be increased to equal V1. The resultant V2 will be increased by the same amount that VR was increased.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF Speeds

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver speeds. Using VREF as the basis for the schedule makes it variable as a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assume an engine failure at the critical point during the takeoff.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush depths greater than 13mm (0.5 inches) are not recommended because of possible airplane damage as a result of slush impingement on the airplane structure. The use of assumed temperature for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight is determined as follows:

- (1) Determine the dry field/obstacle limit weight for the takeoff flap setting.
- (2) Enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.
- (3) Adjust field length available for temperature by amount shown on chart.

(4) Enter the V1(MCG) Limit Weight table with the field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

(1) Determine takeoff speeds V1, VR and V2 for actual brake release weight using Takeoff Speeds from the Performance Dispatch chapter or from the FMC.

(2) If V1(MCG) limited, set $V1 = V1(MCG)$. If not limited by V1(MCG) considerations, enter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than V1(MCG), set $V1 = V1(MCG)$.

Slippery Runway

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on reversers operating and a 15 ft screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Go-Around %N1

To find Go-Around %N1 based on normal engine bleed for packs on and anti-ice off, enter the Go-Around %N1 table with airport pressure altitude and reported OAT or TAT and read %N1. %N1 adjustments are shown for engine bleeds for various conditions.

Max Climb %N1

This table shows Max Climb %N1 for a 310/.84 climb speed schedule, normal engine bleed for packs on and anti-ice off. Enter the table with airport pressure altitude and TAT and read %N1. %N1 adjustments are shown for anti-ice operation.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Body attitude and average %N1 information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome may also cause unreliable airspeed/Mach indications. Climb, cruise and descent information is based on the recommended turbulent air penetration speed schedule: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and above; maintain a minimum speed of 15 knots above the minimum maneuvering speed when below 0.82 Mach. This schedule provides ample protection from stall and high speed buffet, while also providing protection from exceeding structural limits.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. Note that these tables consider both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43100 ft.

Long Range Cruise Control

These tables provide target %N1, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude, .84 Mach approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .84/310/250 descent. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent at .84/310/250

Distance and time for descent are shown for a .84/310/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing Flaps 30 at the outer marker.

Holding

Target %N1, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the FMC optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed for the selected flap setting. Flaps 1 is based on VREF30 + 60 speed schedule. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read %N1, IAS and fuel flow per engine.

Advisory Information

Normal Configuration Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and slippery runways with good, medium, and poor reported braking action. These values are actual landing distances and do not include the 1.67 regulatory factor. Therefore, they cannot be used to determine the dispatch required landing field length.

To use these tables, determine the reference landing distance for the selected braking configuration. Then adjust the reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers to obtain the actual landing distance.

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. If the surface is affected by water, snow, or ice, and the braking action is reported as "good", conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate "poor" data reflects runways covered with wet ice.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" braking action, the airplane may not be able to achieve these deceleration rates. In these cases, runway slope and inoperative reversers influence the stopping distance. Since it cannot be determined quickly when this becomes a factor, it is appropriate to add the effects of slope and inoperative reversers when using the autobrake system.

Non-Normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances and adjustments are provided for dry runways and runways with good, medium, and poor reported braking action.

Enter the table with the applicable non-normal configuration and read the normal approach speed. The reference landing distance is a reference distance from 50 ft above the threshold to stop based on a reference landing weight and speed at sea level, zero wind, and zero slope. Subsequent columns provide corrections for off-reference landing weight, altitude, wind, slope, and speed conditions. Each corrections is independently added to the reference landing distance. Landing distance includes the effects of max manual braking and reverse thrust.

For an engine inoperative autoland, check the rate of climb capability shown in Gear Down Landing Rate of Climb Available tables to ensure adequate climb performance.

Landing Climb Limit Weight

In the event an overweight landing is necessary and the fuel dump system is unavailable, landing climb limits should be checked if a Flaps 25 or 30 landing is planned. Enter the table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required. At weights exceeding those shown, plan a Flaps 20 landing.

Recommended Brake Cooling Schedule

Advisory information is provided to assist in avoiding problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Recommended Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind, at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the appropriate Event Adjusted Brake Energy Table (No Reverse Thrust or 2 Engine Reverse) with the reference brake energy per brake and the type of

braking used during landing (Max Manual, Max Auto, or Autobrake). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing. The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Brake Temperature Monitor System (BTMS) indications are also shown. If brake cooling is determined from the BTMS, the hottest brake indication 10 to 15 minutes after the airplane has come to a complete stop, or inflight with gear retracted, may be used to determine recommended cooling schedule by entering at the bottom of the chart. An EICAS advisory message, BRAKE TEMP, will appear when any brake registers 5.0 or higher on the EICAS indication and disappear as the hottest brake cools with an EICAS indication of 3.5. Note that even without an EICAS advisory message, brake cooling is recommended.

Engine Inoperative

Initial Max Continuous %N1

The Initial Max Continuous %N1 setting for use following an engine failure is shown. The table is based on the typical all engine cruise Mach number of .84 to provide a target %N1 setting at the start of driftdown. Once driftdown is established, the Max Continuous %N1 Table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Power setting is based on one engine operating with engine bleed for packs on or off and all anti-ice bleeds off. Enter the table with pressure altitude and IAS or Mach to read %N1.

It is desirable to maintain engine thrust level within the limits of the Max Cruise thrust rating. However, where thrust level in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/Cruise Range Capability

This table shows the range capability from the start of driftdown.

Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to long range cruise speed. Cruise is continued at level off altitude and long range cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and correct for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required. If altitudes other than the level off altitude is used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

Table show the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on LRC speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target %N1, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (LB/HR)				
	GROSS WEIGHT (1000 LB)				
	700	600	500	400	300
43				360	310
39			420	360	310
35		470	420	380	300
31	520	500	450	370	310
25	510	490	440	380	340
20	520	520	460	410	360
15	520	520	480	440	400
10	540	520	510	490	440
5	590	590	570	530	480

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on single engine Long Range Cruise speed and .84/310/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion Table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the off reference fuel corrections table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down Landing Rate of Climb Available

Rate of climb data is provided as guidance information in the event an engine inoperative autoland is planned. The tables show gear down rate of climb available for Flaps 20 and Flaps 30. Enter the table with TAT and pressure altitude to read rate of climb available. Apply adjustments shown to correct for weight.

Alternate Mode EEC

No takeoff speed adjustments or other performance adjustments are required for operation of EEC in the ALTERNATE mode. Power setting adjustments are only required for the takeoff thrust rating.

Max Takeoff %N1

Takeoff power settings are presented for normal air condition bleed. Max Takeoff %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode and maximum rated thrust is reached at a thrust lever position less than full forward. As a result, thrust overboost can occur at full forward thrust lever positions.

Gear Down

This section contains performance for airplane operation with the landing gear extended for all phases of flight. The data is based on engine bleeds for normal air conditioning.

Note: The Flight Management Computer System (FMCS) does not contain special provisions for operation with landing gear extended. As a result, the FMCS will generate inaccurate enroute speed schedules, display non-conservative predictions of fuel burn, estimated time of arrival (ETA), maximum altitude, and compute overly shallow descent path. To obtain accurate ETA predictions, gear down cruise speed and altitude should be entered on the CLB and CRZ pages. Gear down cruise speed should also be entered on the DES page and a STEP SIZE of zero should be entered on the PERF INIT or CRZ page. Use of VNAV during descent under these circumstances is not recommended.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

Intentionally
Blank

**Airplane General, Emergency
Equipment, Doors, Windows
Table of Contents****Chapter 1****Section 0**

Dimensions	1.10
Principal Dimensions	1.10.1
Turning Radius	1.10.6
Instrument Panels.....	1.20
Flight Deck Panels	1.20.1
Inst. Panels, Overhead	1.21
Overhead Panel	1.21.1
Overhead Maintenance Panel	1.21.3
Inst. Panels, Fwd.....	1.22
Left Forward Panel	1.22.1
Right Forward Panel	1.22.2
Glareshield Panel	1.22.3
Center Forward Panel	1.22.4
EICAS Display	1.22.5
Forward Aisle Stand	1.22.6
Multifunction Display.....	1.22.7
Inst. Panels, Aft and Side.....	1.23
Control Stand.....	1.23.1
Aft Aisle Stand.....	1.23.2
Left and Right Sidewall, First Observer, and Maintenance Access Terminal/Second Observer Panels	1.23.4
Controls and Indicators	1.30
Push-Button Switches	1.30.1
Alternate Action Switches	1.30.1
Momentary Action Switches	1.30.2
Signs and Lighting.....	1.30.3
Lighting Panel.....	1.30.6

Miscellaneous Lighting Controls	1.30.7
Flight Deck Emergency Lights Switch	1.30.7
Cabin Emergency Lights Switch	1.30.8
Floor Lights Switch	1.30.9
Aisle Stand Panel/Flood Light Control	1.30.9
Map Light Control	1.30.10
Forward Panel Brightness Controls	1.30.10
Main Deck Cargo Lighting Control	1.30.11
Supernumerary Lighting Control	1.30.12
Doors and Windows	1.30.13
Door Synoptic Display	1.30.13
Entry Door	1.30.15
Overwing Emergency Exit Door	1.30.16
Door Mode Select Panel	1.30.18
Flight Deck Door	1.30.20
Flight Deck Number Two Window	1.30.23
Main Deck Cargo Door Video	1.30.24
Main Deck Cargo Door Controls	1.30.25
Oxygen Systems	1.30.26
Oxygen Indications	1.30.26
Passenger Oxygen Switch	1.30.28
Supernumerary Oxygen Switch	1.30.29
Oxygen Mask Panel	1.30.30
Oxygen Mask and Regulator	1.30.31
Emergency Evacuation Panel	1.30.32
Fuselage Mounted Emergency Locator Transmitter	1.30.33
Water and Waste Indicators	1.30.33
Systems Description	1.40
Introduction	1.40.1
Lighting Systems	1.40.1
Exterior Lighting	1.40.1
Exterior Lighting Locations	1.40.3
Flight Deck Lighting	1.40.3

Master Brightness Control System	1.40.4
Cabin Lighting	1.40.4
Cabin Signs	1.40.4
Emergency Lighting	1.40.5
Oxygen Systems	1.40.11
Flight Crew Oxygen System	1.40.11
Passenger Oxygen System	1.40.12
Supernumerary Oxygen System	1.40.13
Lower Crew Rest Compartment (LCR)	1.40.13
Door 1 Upper Crew Rest Compartment	1.40.13
Door 3 Upper Crew Rest Compartment	1.40.13
Door 4 Upper Crew Rest Compartment	1.40.14
Door 5 Upper Crew Rest Compartment	1.40.14
Emergency Equipment	1.45
Emergency Equipment Overview	1.45.1
Emergency Evacuation Signal System	1.45.1
Emergency Locator Transmitter (ELT)	1.45.2
Passenger Cabin	1.45.2
Freighter	1.45.2
Fuselage Mounted Emergency Locator Transmitter (ELT)	1.45.2
Miscellaneous Portable Emergency Equipment	1.45.2
Passenger Airplane	1.45.2
Freighter Airplane	1.45.2
Fire Extinguishers	1.45.3
Halon Fire Extinguishers	1.45.3
Water Fire Extinguishers	1.45.4
Portable Oxygen Bottles	1.45.4
Flashlights	1.45.5
Emergency Equipment Symbols	1.45.6
Emergency Equipment Locations - Passenger Airplane	1.45.6
Flight Deck	1.45.6
Passenger Cabin	1.45.7

Emergency Equipment Locations - Freighter.	1.45.13
Flight Deck / Supernumerary Area	1.45.13
Main Deck.	1.45.14
Flight Crew Rest	1.46
Introduction	1.46.1
Flight Crew Rest (FCR)	1.46.1
Crew Rest Smoke Detection	1.46.3
Amenities Module.	1.46.6
Overhead Crew Rest.	1.47
Introduction	1.47.1
Door 1 Upper Crew Rest	1.47.1
Occupancy.	1.47.2
Entrance Enclosure	1.47.4
Crew Rest Layout	1.47.8
Temperature Control System	1.47.11
Oxygen System	1.47.13
Decompression	1.47.14
Emergency Equipment	1.47.17
Evacuation using the Emergency Hatch	1.47.18
Door 3 Upper Crew Rest	1.47.22
Occupancy.	1.47.22
Entrance Enclosure	1.47.22
Crew Rest Layout	1.47.27
Temperature Control System	1.47.28
Oxygen System	1.47.30
Decompression	1.47.31
Emergency Equipment	1.47.33
Evacuation using the Emergency Hatch	1.47.35
Door 5 Upper Crew Rest	1.47.38
Occupancy.	1.47.38
Entrance Enclosure	1.47.39
Crew Rest Layout	1.47.44
Temperature Control System	1.47.45

Oxygen System	1.47.47
Decompression	1.47.48
Emergency Equipment	1.47.50
Evacuation using the Emergency Hatch	1.47.52
Lower Crew Rest	1.48
Introduction	1.48.1
Lower Crew Rest (LCR) Compartment	1.48.1
Entrance Enclosure	1.48.2
Main Entry Hatch	1.48.3
Emergency Hatch	1.48.4
Lower Crew Rest Attendant Switch Panel	1.48.5
LCR Layout	1.48.8
LCR Fire Protection	1.48.9
Doors, Windows, Seats	1.50
Introduction	1.50.1
Doors and Windows	1.50.1
Flight Deck Door	1.50.1
Flight Deck Number Two Windows	1.50.3
Entry Doors	1.50.4
Entry Door Slide/Raft	1.50.5
Overwing Escape Slide	1.50.6
Emergency Exit Operation	1.50.6
Cargo Doors	1.50.13
Flight Deck Seats	1.50.14
Pilot Seats	1.50.15
Pilot Seat Adjustment	1.50.17
Observer Seats	1.50.17
EICAS Messages	1.60
Airplane General, Emergency Equipment, Doors, Windows	
EICAS Messages	1.60.1
EICAS Memo Messages	1.60.3

Intentionally
Blank

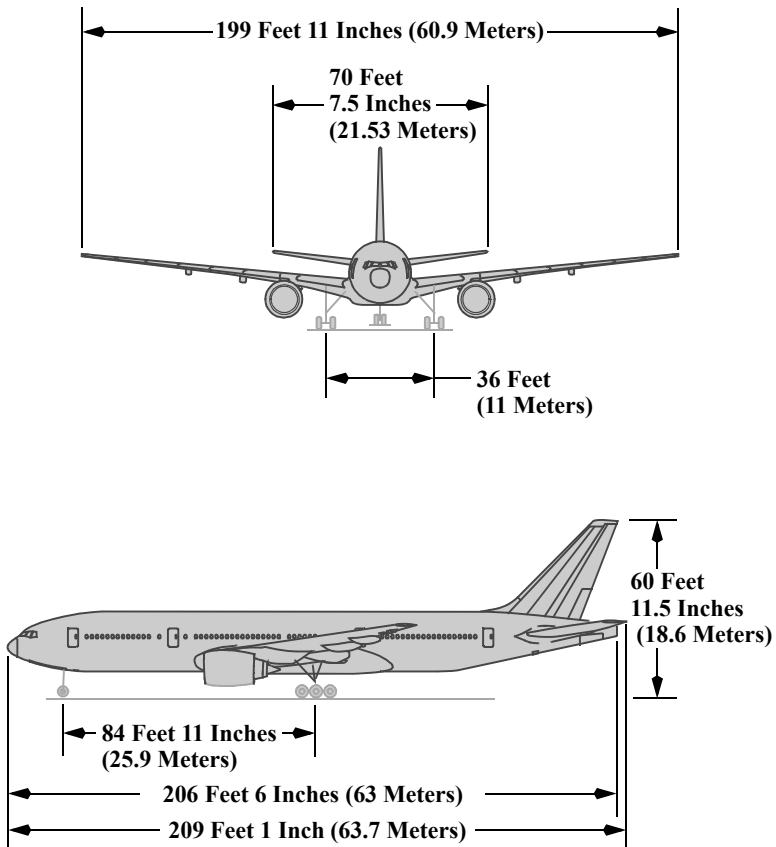
**Airplane General, Emergency
Equipment, Doors, Windows
Dimensions**

Chapter 1

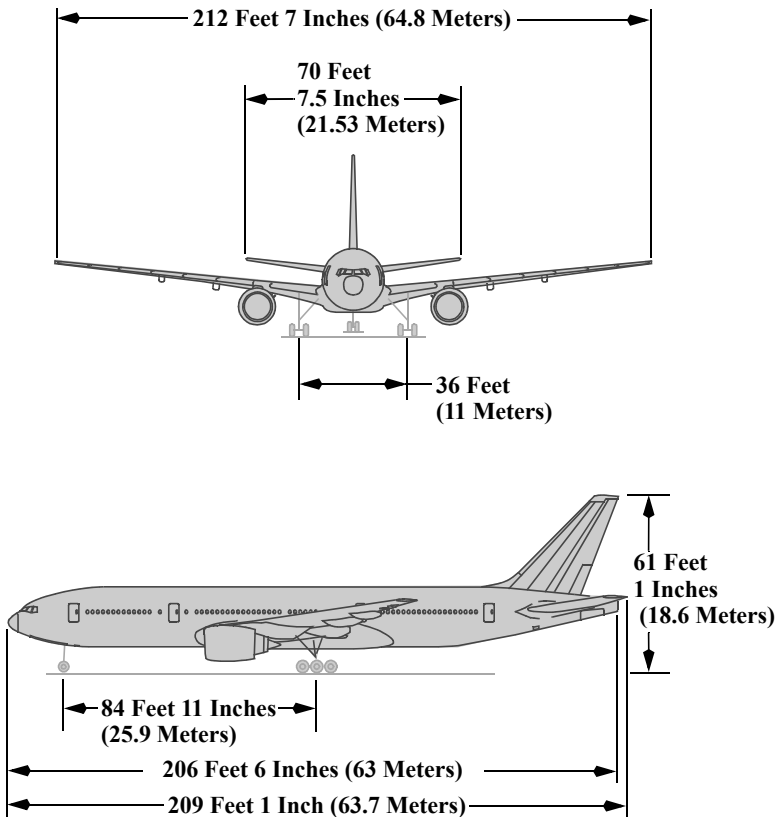
Section 10

Principal Dimensions

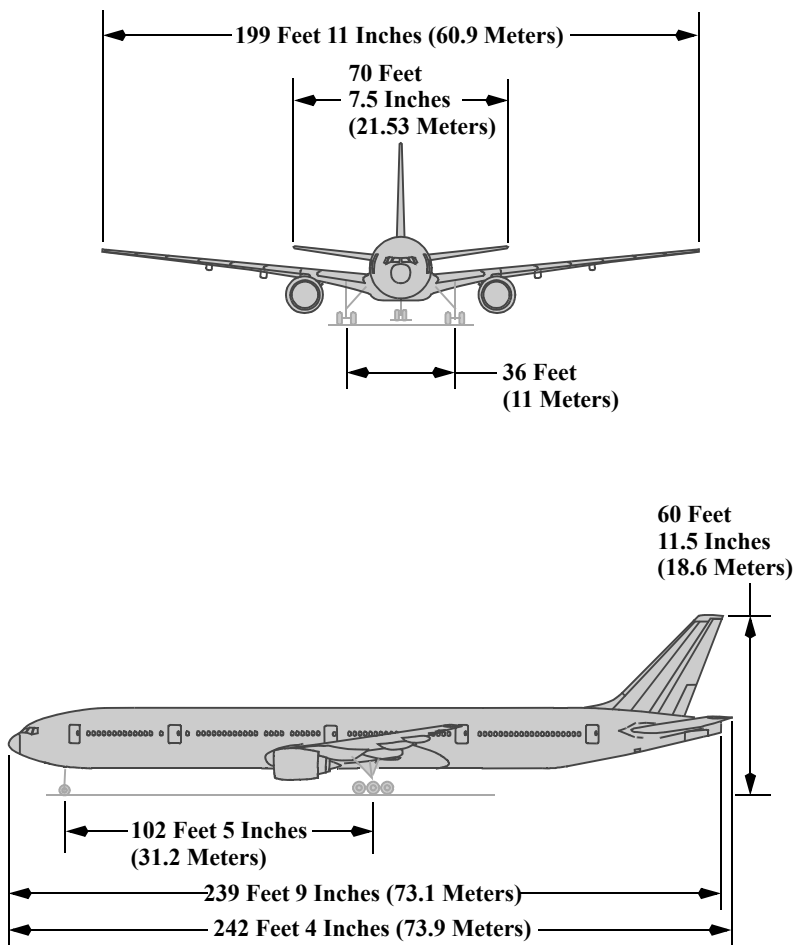
[777-200 and 777-200ER]



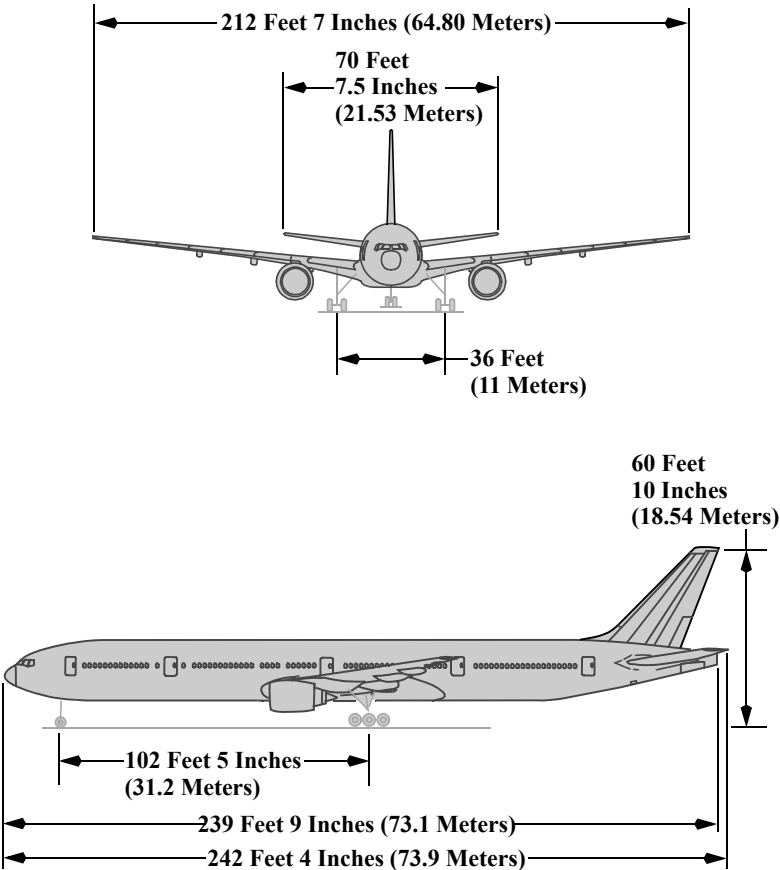
[777-200LR]



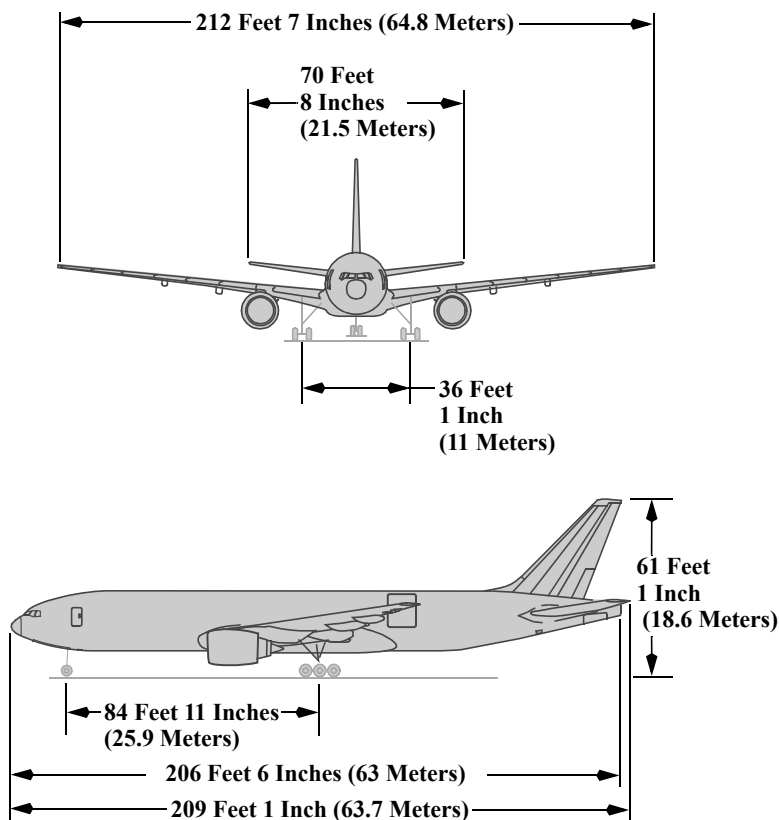
[777-300]



[777-300ER]



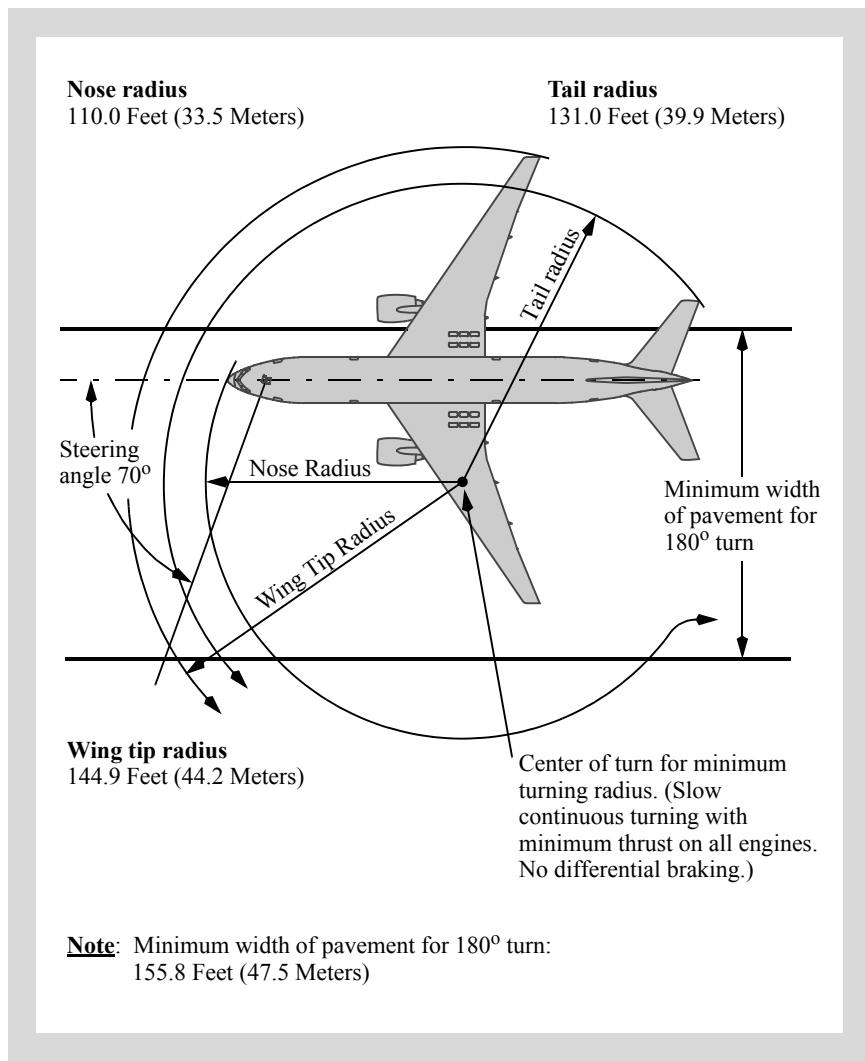
[777F]



Turning Radius

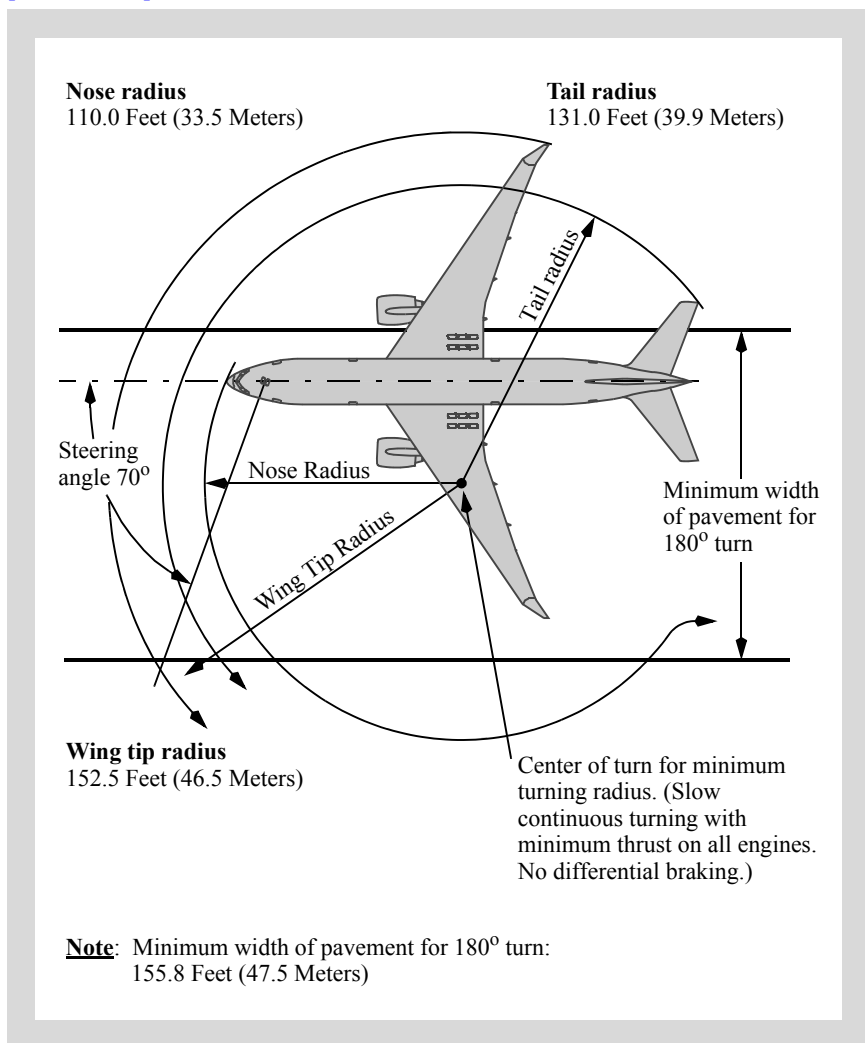
The wing tip swings the largest arc while turning and determines the minimum obstruction clearance path. All other portions of the airplane structure remain within this arc.

[777-200 and 777-200ER]



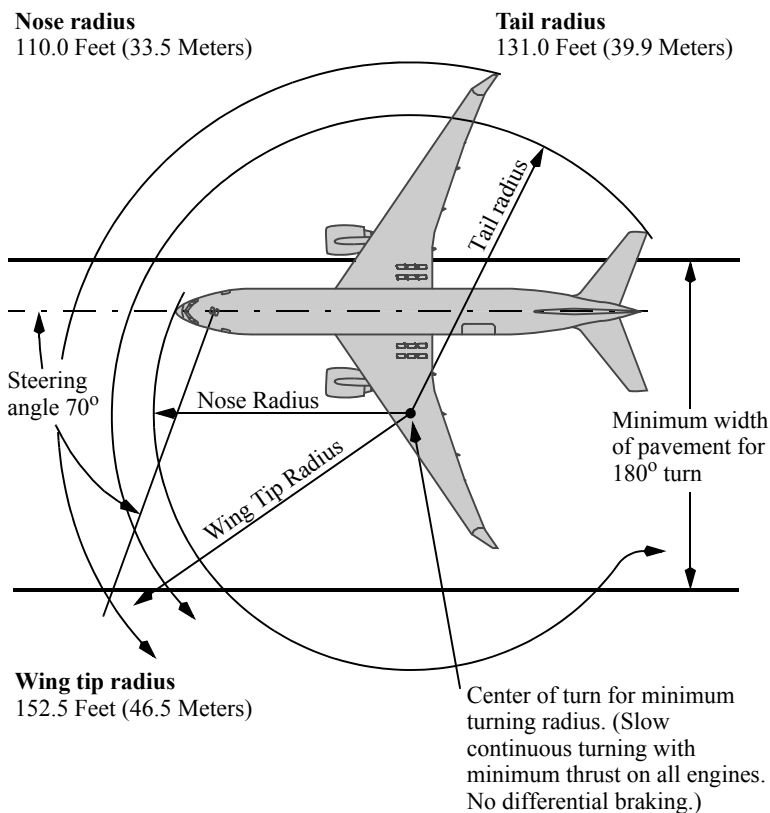
CAUTION: Do not attempt to make a turn away from an obstacle within 15 feet (4.6 m) of the wing tip, or within 50 feet (15.2 m) of the nose.

[777-200LR]



CAUTION: Do not attempt to make a turn away from an obstacle within 15 feet (4.6 m) of the wing tip, or within 55 feet (16.8 m) of the nose.

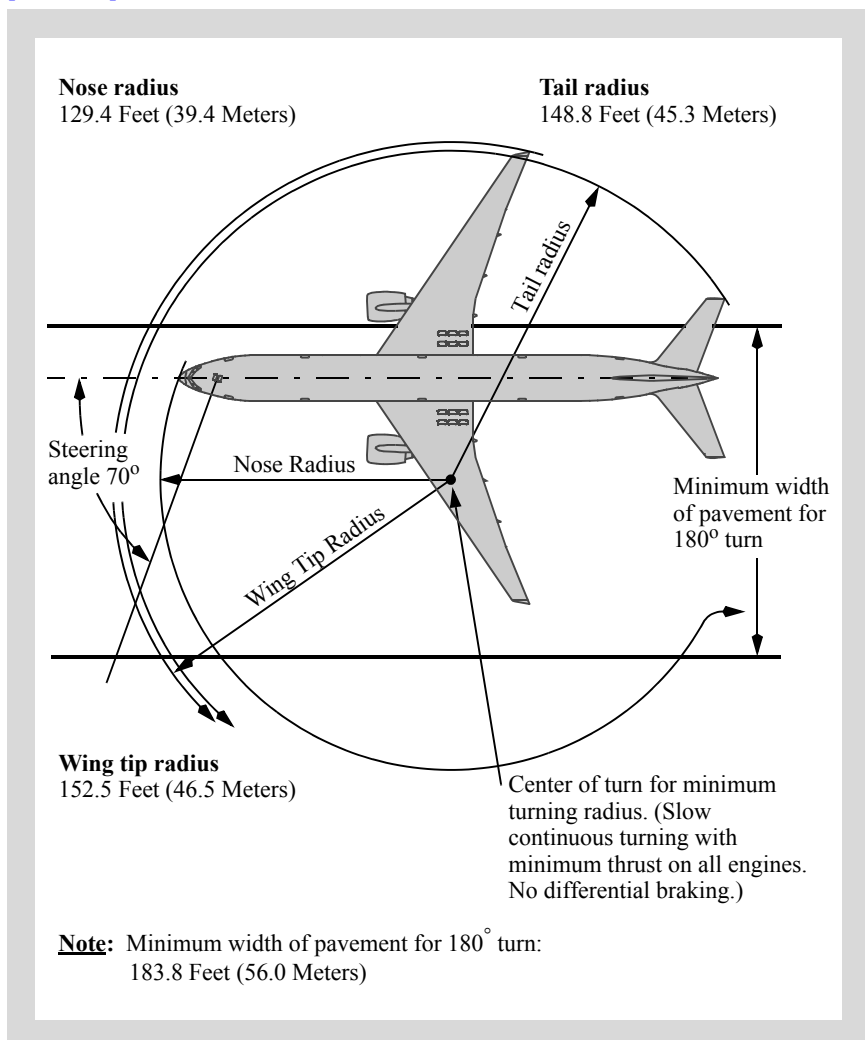
[777F]



Note: Minimum width of pavement for 180° turn:
155.8 Feet (47.5 Meters)

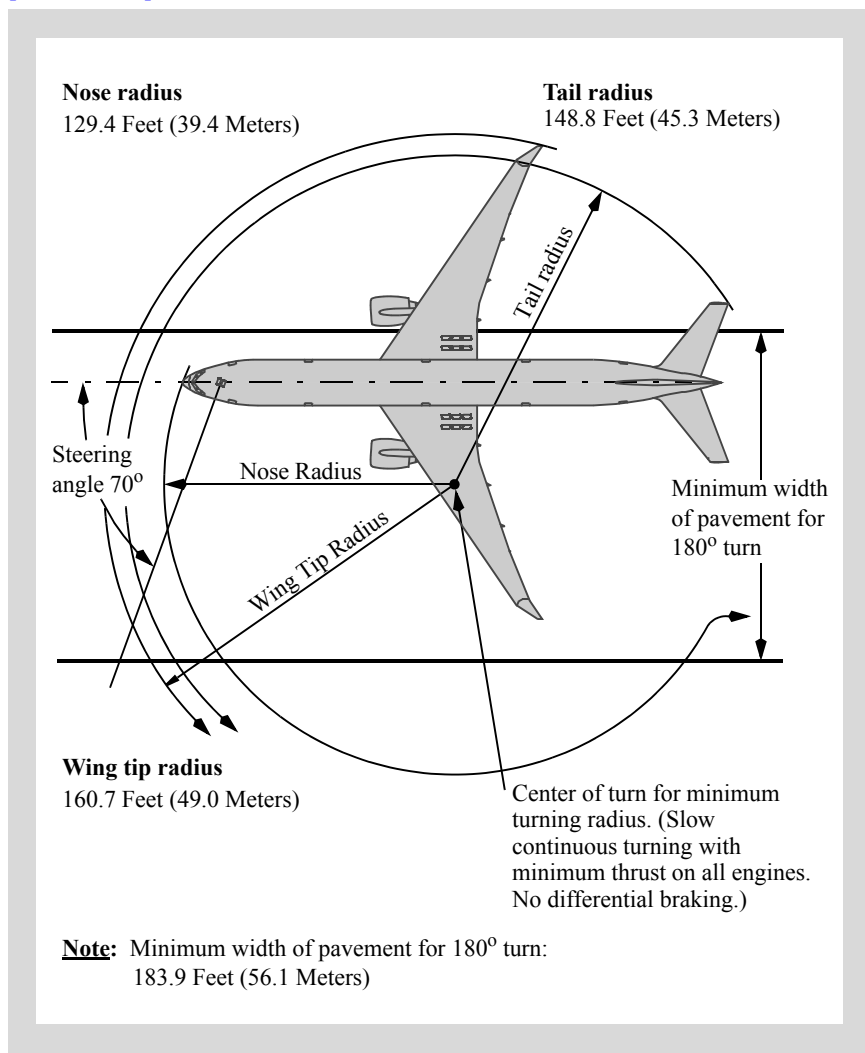
CAUTION: Do not attempt to make a turn away from an obstacle within 15 feet (4.6 m) of the wing tip, or within 55 feet (16.8 m) of the nose.

[777-300]

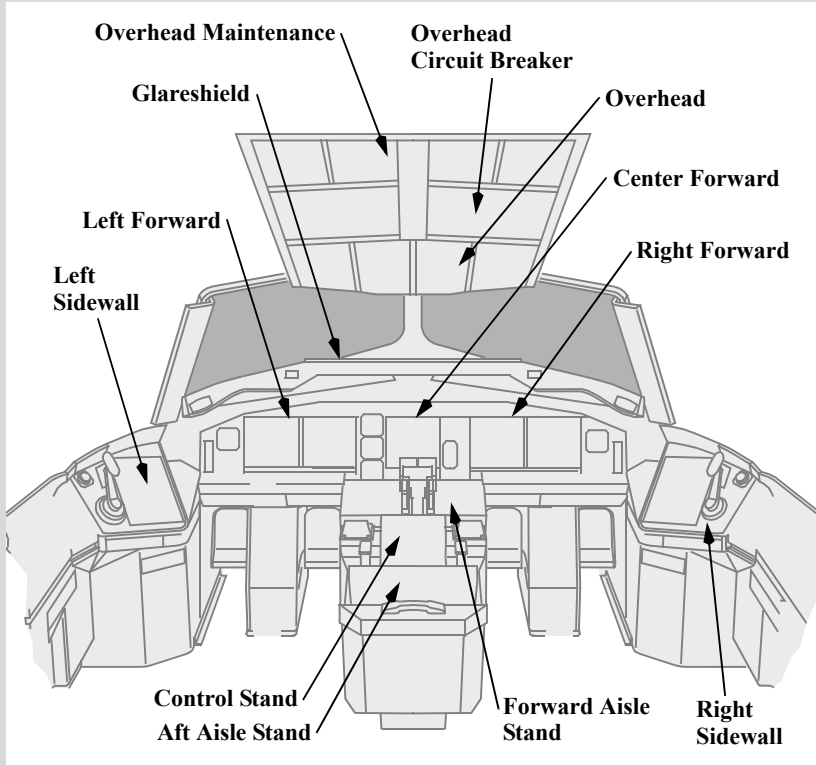


CAUTION: Do not attempt to make a turn away from an obstacle within 15 feet (4.6 m) of the wing tip, or within 39 feet (11.9 m) of the nose.

[777-300ER]



CAUTION: Do not attempt to make a turn away from an obstacle within 15 feet (4.6 m) of the wing tip, or within 45 feet (13.9 m) of the nose.

**Airplane General, Emergency
Equipment, Doors, Windows
Instrument Panels****Chapter 1****Section 20****Flight Deck Panels**

On the following pages, circled numbers refer to chapters where information on the item may be found.

The panels, controls, and indicators shown in this chapter are representative of installed units and may not exactly match the latest configuration. Refer to the appropriate chapter system descriptions for current information.

Customer options are shown in [brackets]; for example, [Option – PW Engines] means airplanes with Pratt and Whitney engines.

Intentionally
Blank

Airplane General, Emergency Equipment, Doors, Windows

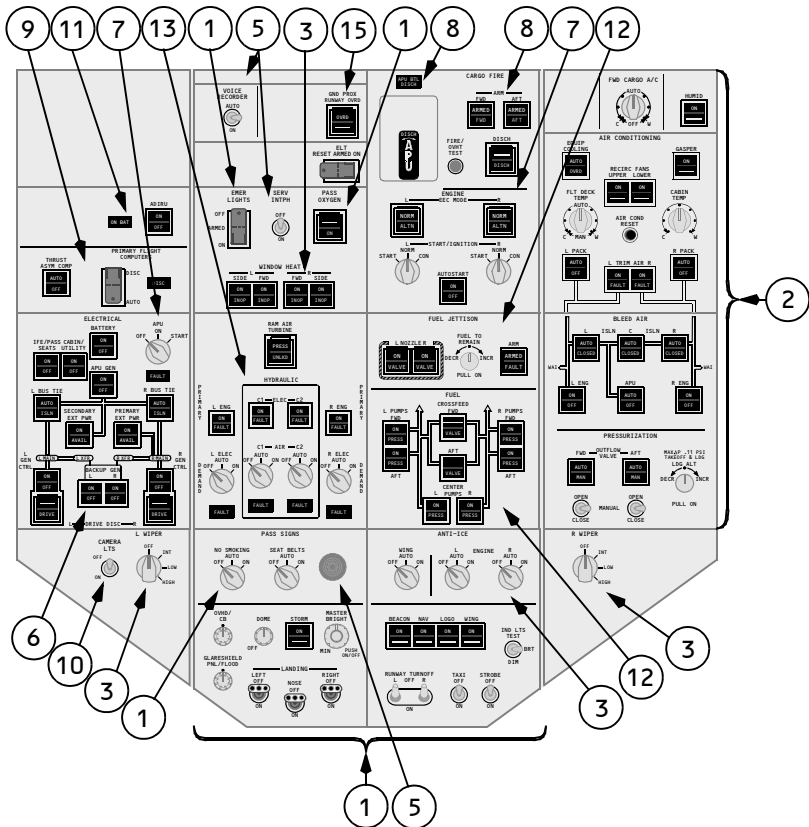
Inst. Panels, Overhead

Chapter 1

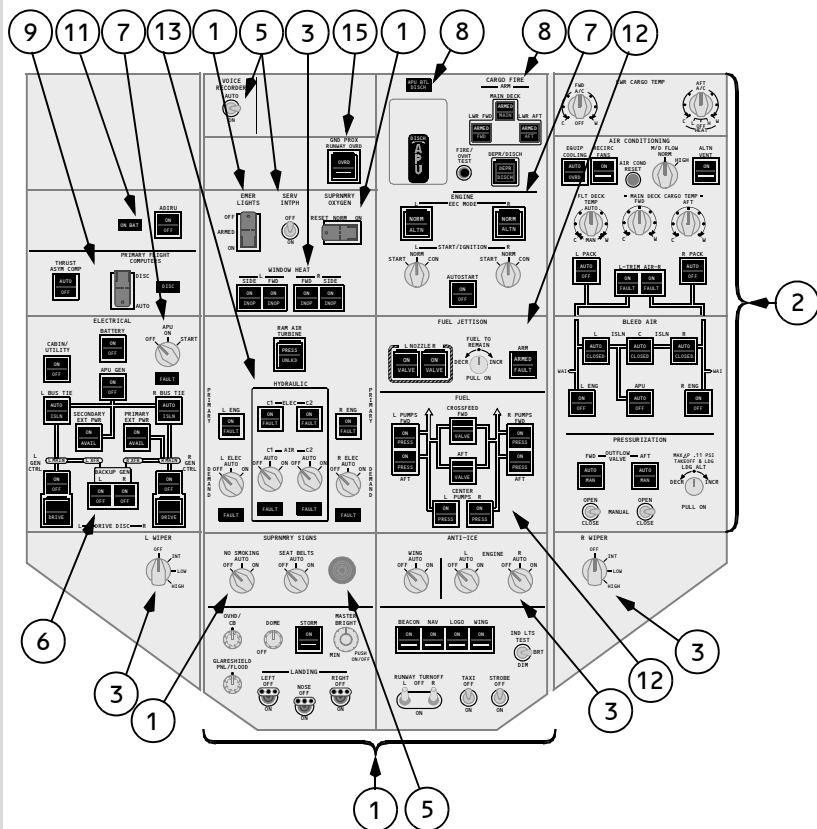
Section 21

Overhead Panel

[Passenger - Typical]

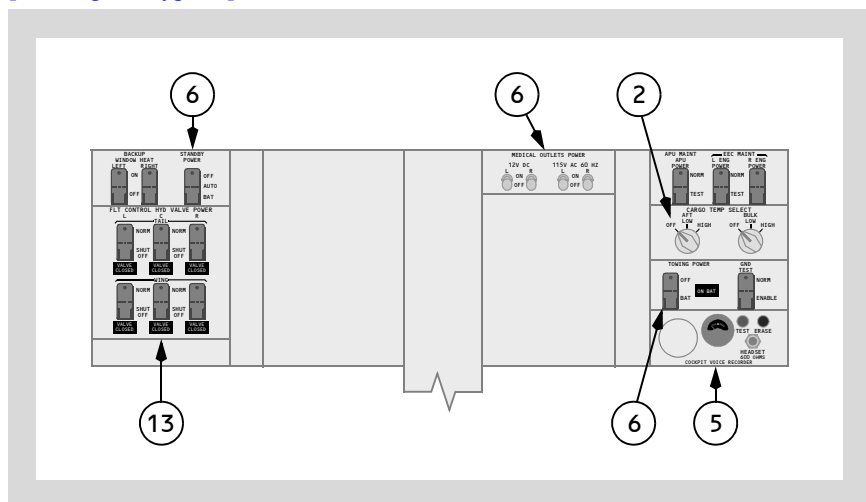


[Freighter - Typical]

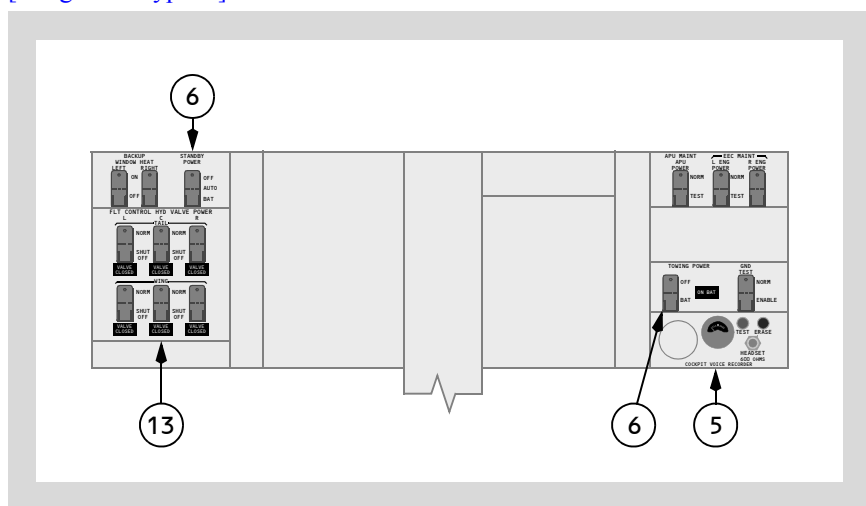


Overhead Maintenance Panel

[Passenger - Typical]



[Freighter - Typical]



Intentionally
Blank

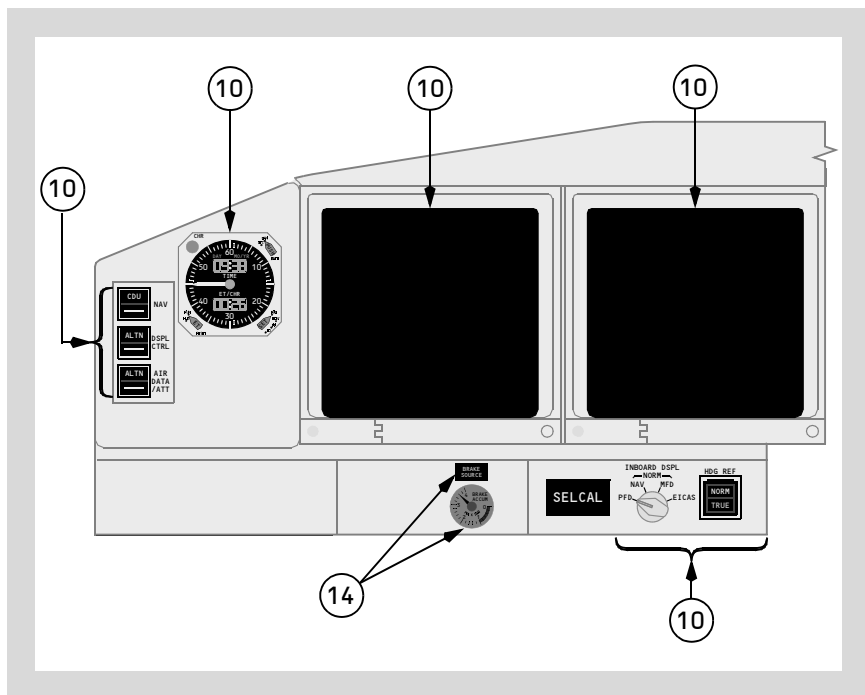
**Airplane General, Emergency
Equipment, Doors, Windows
Inst. Panels, Fwd**

Chapter 1

Section 22

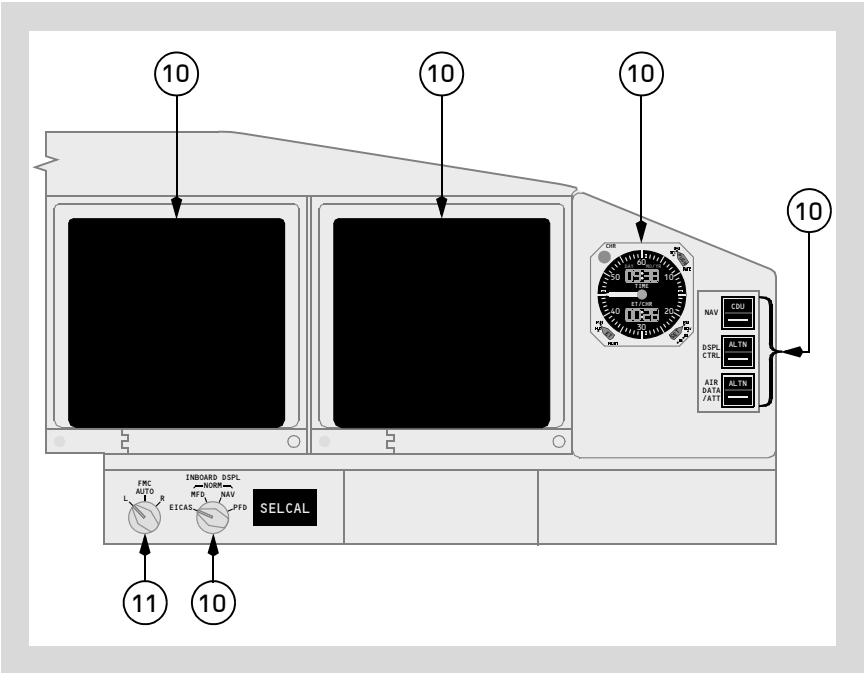
Left Forward Panel

[Typical]



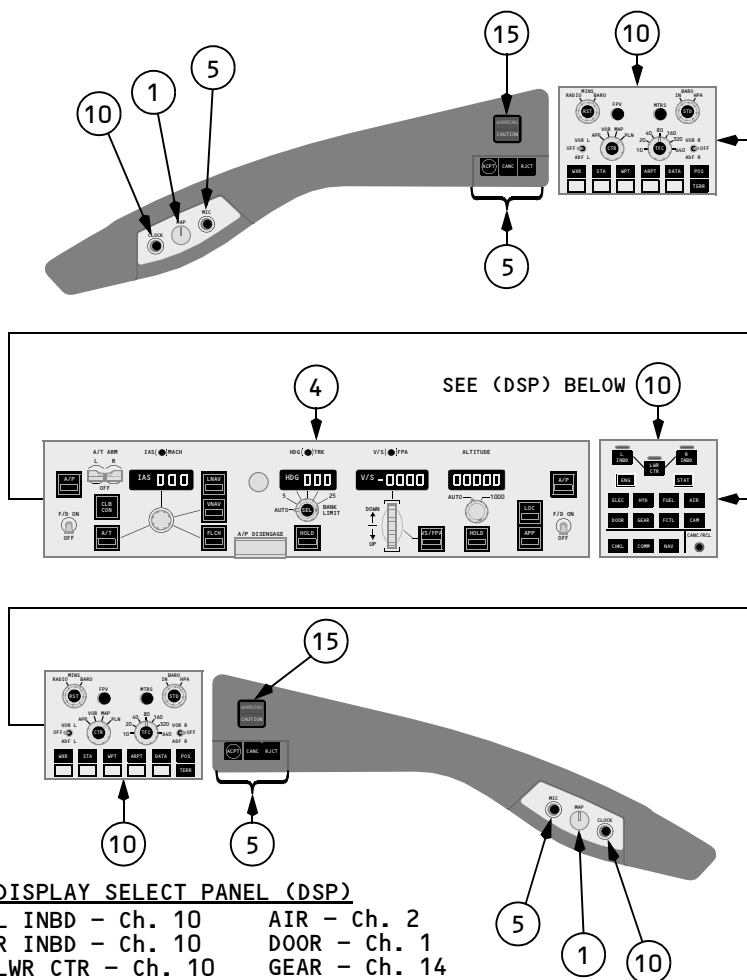
Right Forward Panel

[Typical]

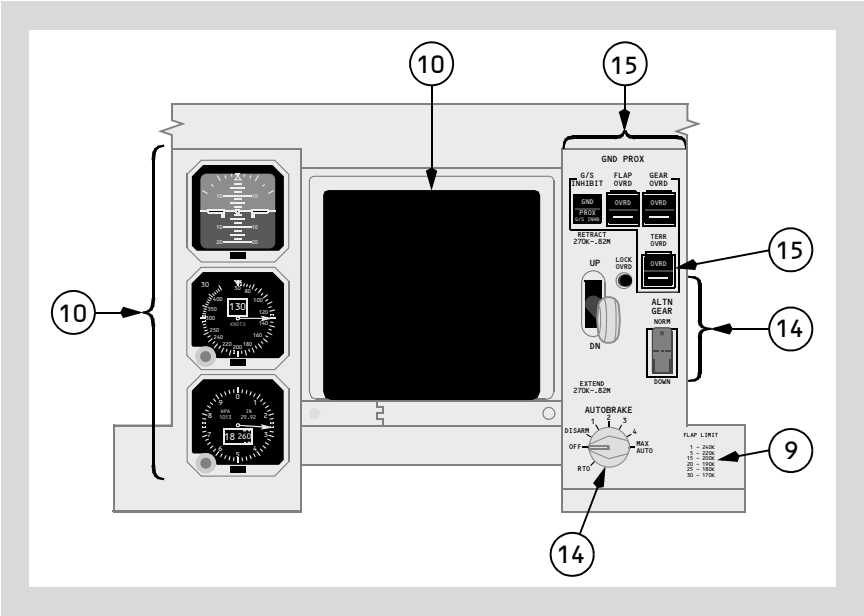


Glareshield Panel

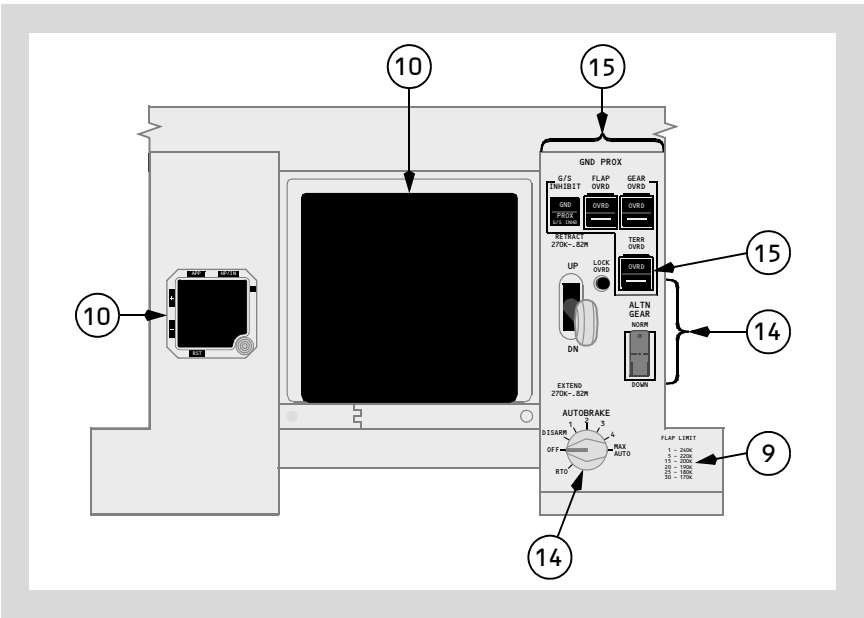
[Typical]



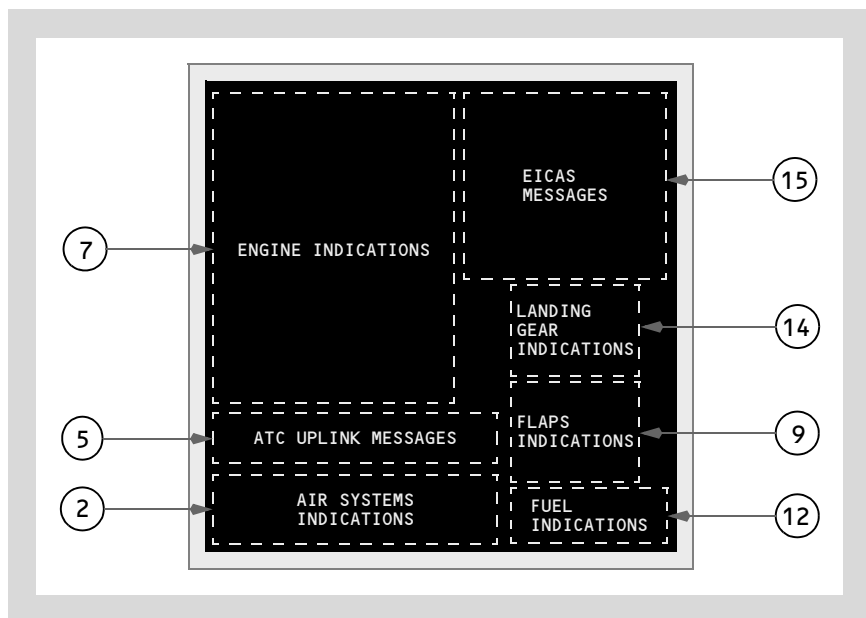
Center Forward Panel



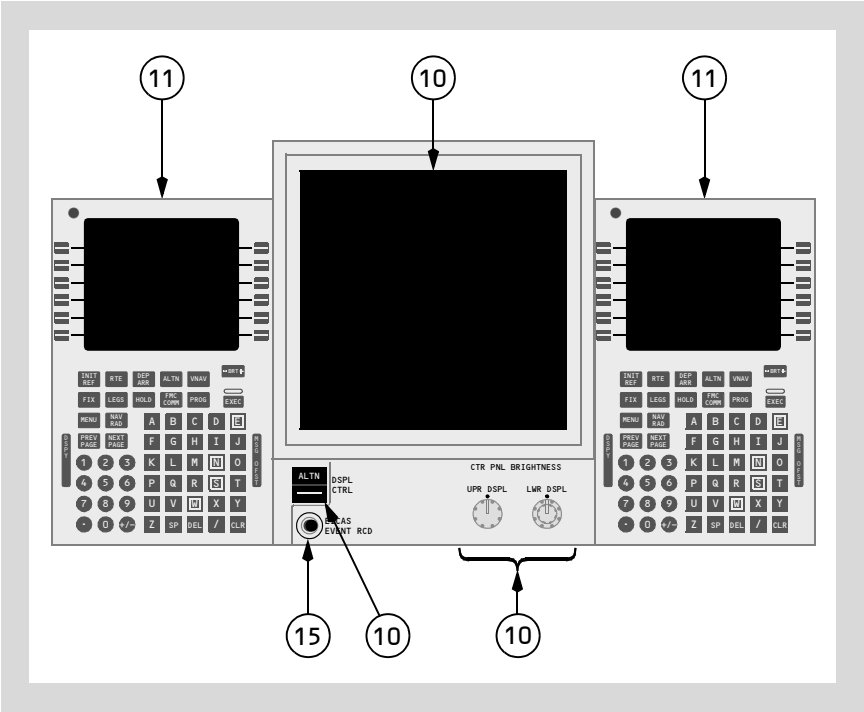
[Integrated Standby Flight Display Installed]



EICAS Display



Forward Aisle Stand

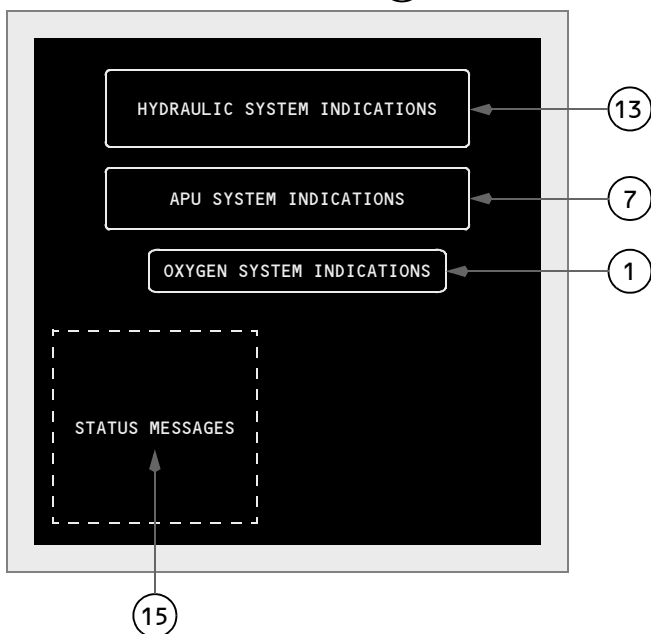


Multifunction Display

MULTIFUNCTION DISPLAY FORMATS

SECONDARY ENGINE DISPLAY ← (7)
STATUS DISPLAY (SHOWN BELOW)
SYNOPTICS:

ELEC ← (6)
HYD ← (13)
FUEL ← (12)
AIR ← (2)
DOOR ← (1)
GEAR ← (14)
FCTL ← (9)
CAM ← (10)



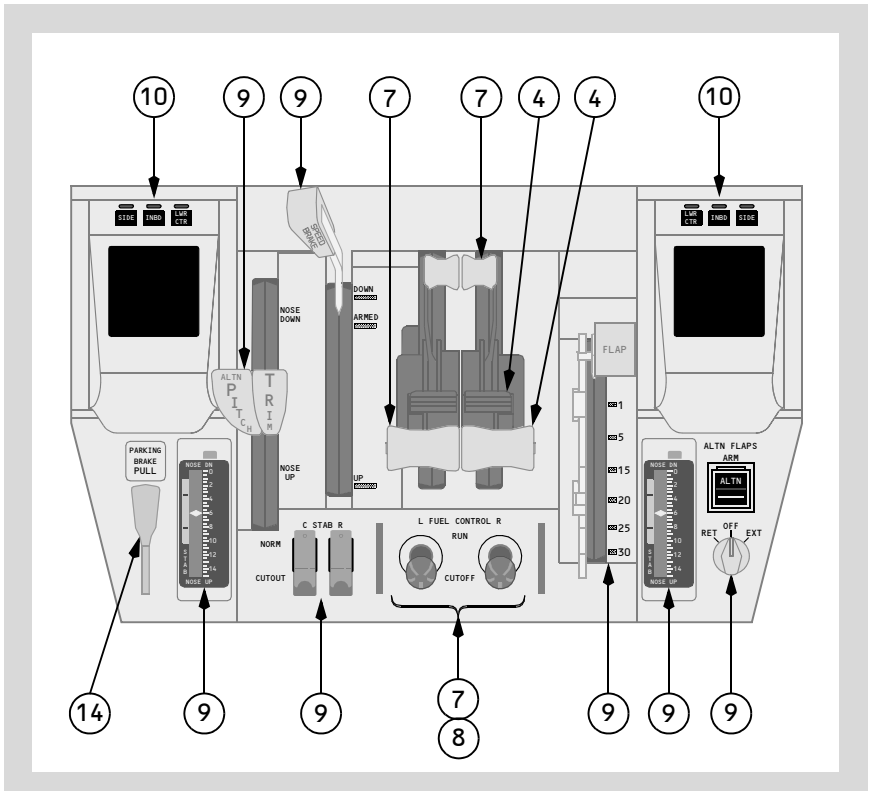
Intentionally
Blank

**Airplane General, Emergency
Equipment, Doors, Windows
Inst. Panels, Aft and Side**

Chapter 1

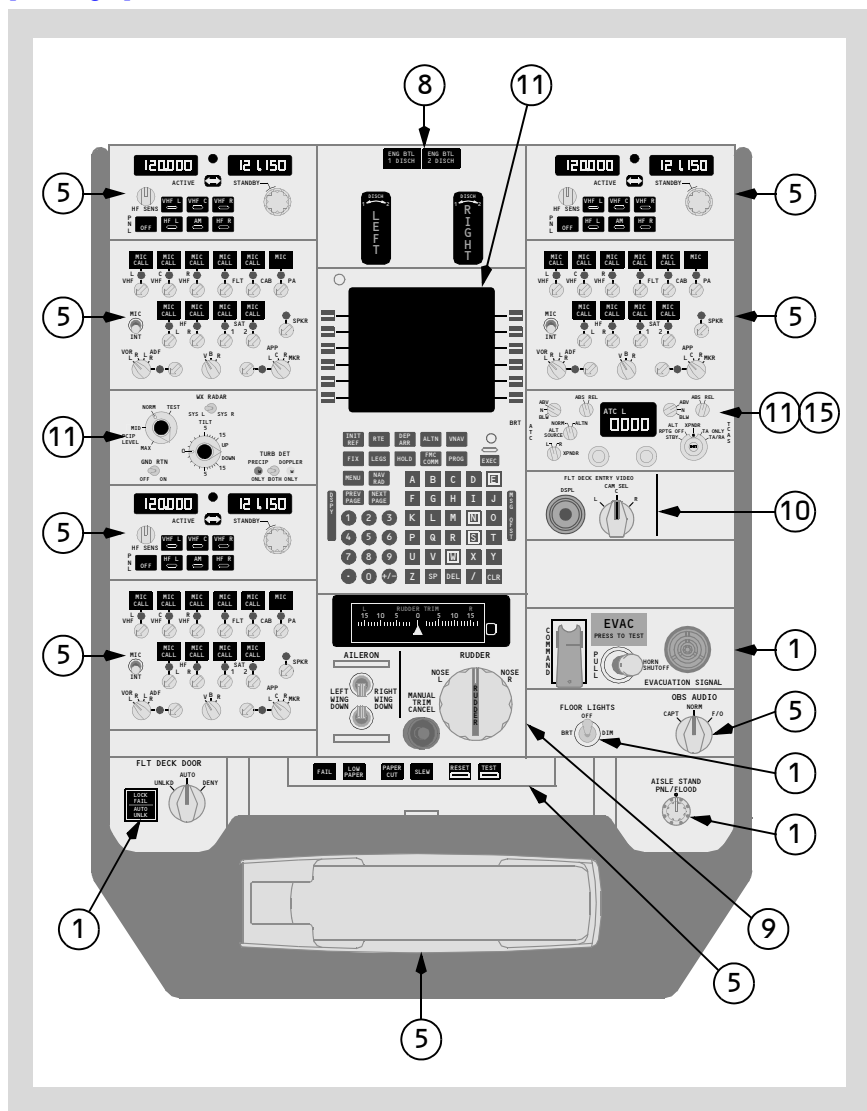
Section 23

Control Stand

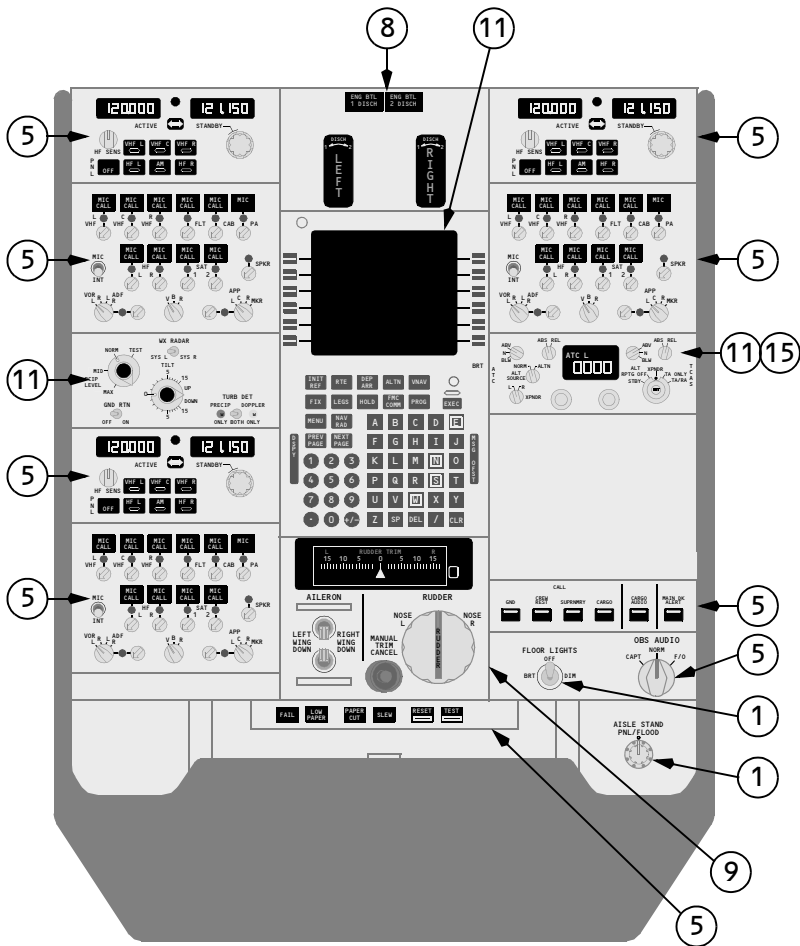


Aft Aisle Stand

[Passenger]

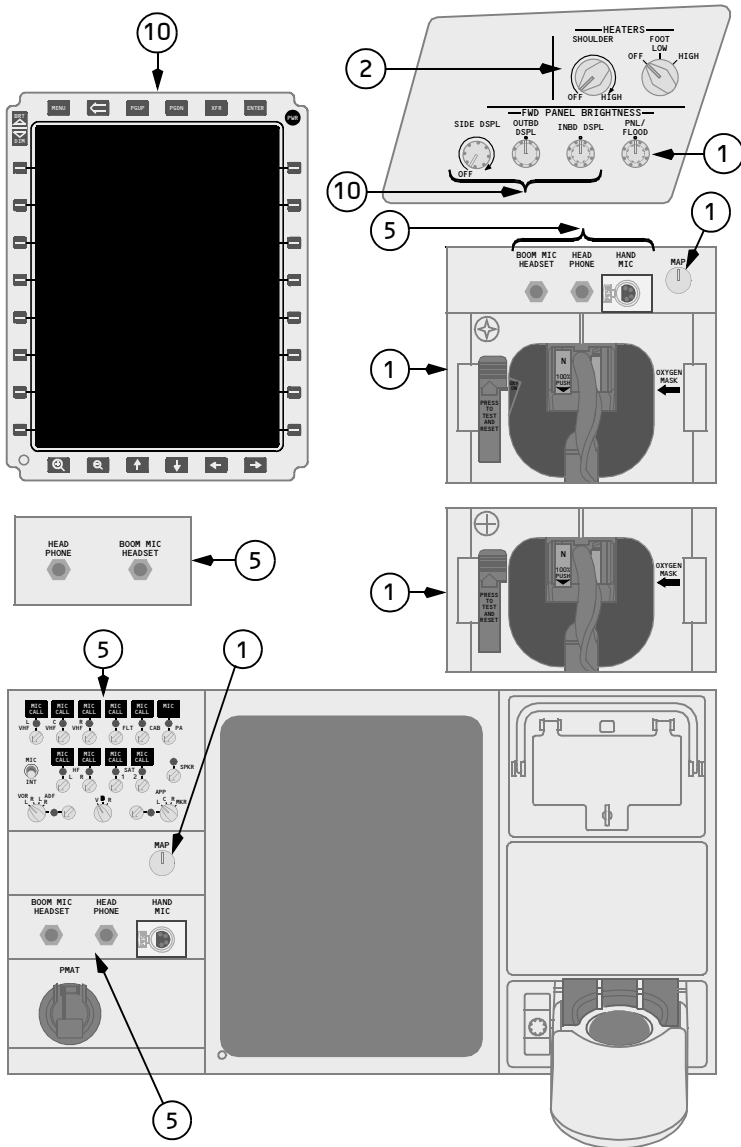


[Freighter]



DO NOT USE FOR FLIGHT

Left and Right Sidewall, First Observer, and Maintenance Access Terminal/Second Observer Panels



**Airplane General, Emergency
Equipment, Doors, Windows
Controls and Indicators****Chapter 1****Section 30****Push–Button Switches**

The airplane has two types of push–button switches: alternate action and momentary action. Both types direct crew attention to system status and faults.

Note: Maintenance personnel should change switch lights. Changing the light requires changing the entire switch cap.

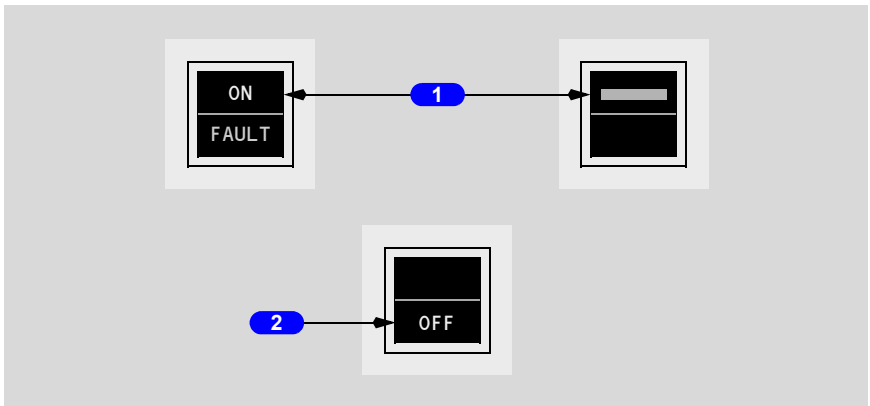
Alternate Action Switches

Alternate action switches have two positions: on and off.

When pushed in and flush with the panel, the switch is on. When the switch is on, a mechanical shutter on the top half of the switch opens to show an illuminated legend, such as "ON", "AUTO" or a flow bar.

When pushed out and extended, the switch is off. When the switch is off, the mechanical shutter closes so the legend is not shown.

Additionally, the bottom half of many switches has a light to indicate system state, such as "PRESS", "FAIL", "INOP", OR "OFF".

**1 Switch is ON**

ON, AUTO, or flow bar visible.

For some switches, system status (FAULT, MAN, OFF, VALVE) may be shown in the lower half of the switch.

2 Switch is OFF

OFF or a line is visible –

- the top of the switch is blank
- a line indicates no label in this portion of the switch.

Momentary Action Switches

Momentary action switches are spring loaded to the extended position. They are used to activate or deactivate systems or to reset system logic. The switch display indicates system status.



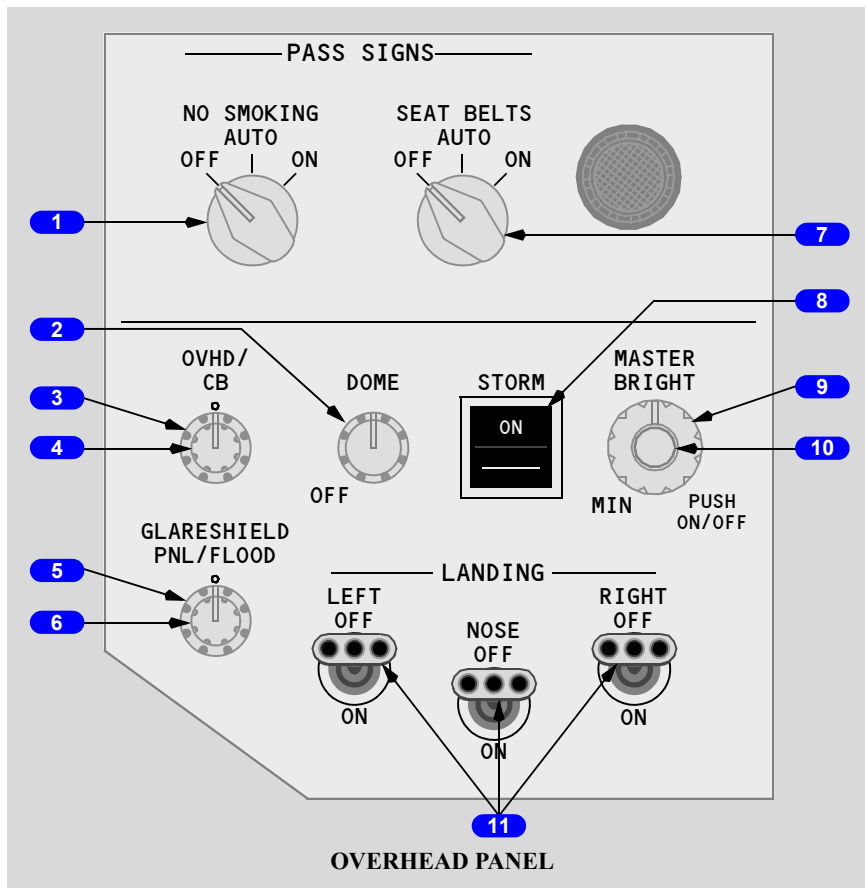
1 Push to Reset

Push – the switch resets the master lights and aural alerts.

2 System Operation

Push – activates or deactivates the system.

Signs and Lighting



1 NO SMOKING Selector

OFF – the NO SMOKING signs are not illuminated.

AUTO – the NO SMOKING signs are illuminated or extinguished automatically with reference to cabin altitude and system configuration (refer to the Lighting System Description section).

ON – the NO SMOKING signs are illuminated.

[Passenger]

Note: Any time passenger oxygen is deployed, the NO SMOKING and FASTEN SEAT BELTS signs illuminate automatically, regardless of the selector position.

[Freighter]

Note: Any time supernumerary oxygen is deployed, the NO SMOKING and FASTEN SEAT BELTS signs illuminate automatically, regardless of the selector position.

2 DOME Light Control

Controls overhead dome light brightness.

3 Overhead (OVHD) Panel Light Control (outer)

Rotate – controls overhead panel light brightness.

4 Circuit Breaker (CB) Panel Light Control (inner)

Rotate – controls circuit breaker panel light brightness.

5 GLARESHIELD Panel (PNL) Light Control (outer)

Rotate – controls glareshield panel light and standby compass brightness.

6 GLARESHIELD FLOOD Light Control (inner)

Rotate – controls glareshield flood light brightness.

7 SEAT BELTS Selector

OFF – the FASTEN SEAT BELTS and RETURN TO SEAT signs are not illuminated.

AUTO – the FASTEN SEAT BELTS and RETURN TO SEAT signs are illuminated or extinguished automatically with reference to airplane altitude and system configuration (refer to the Lighting System Description section).

[Passenger]

ON – the FASTEN SEAT BELTS and RETURN TO SEAT signs are illuminated.

[Freighter]

ON – the FASTEN SEAT BELTS and RETURN TO SEAT signs are illuminated. When selected, the main deck sidewall lights are flashed for several seconds.

[Passenger]

Note: Any time passenger oxygen is deployed, the NO SMOKING and FASTEN SEAT BELTS signs illuminate automatically, regardless of the selector position.

[Freighter]

Note: Any time supernumerary oxygen is deployed, the NO SMOKING and FASTEN SEAT BELTS signs illuminate automatically, regardless of the selector position.

8 STORM Light Switch

ON – overrides normal controls and illuminates the following lights at maximum brightness:

- all illuminated indicator lights
- glareshield flood lights
- instrument panel flood lights
- aisle stand flood lights
- dome lights.

9 MASTER BRIGHTNESS Control (outer)

Rotate (when the MASTER BRIGHTNESS switch is pushed on) –:

- controls the brightness of all panel lights and displays (dome lights, flood lights, and circuit breaker panel lights are not controlled by this switch)
- overrides individual brightness control settings
- limits adjustment range of individual brightness controls
- has full adjustment range of all lights when all individual brightness controls are set to the center detent.

10 MASTER BRIGHTNESS Switch

A black ring on the side of the inner switch is visible when the switch is out (OFF).

PUSH ON (in) – the MASTER BRIGHTNESS control is on.

PUSH OFF (out) – the MASTER BRIGHTNESS control is off.

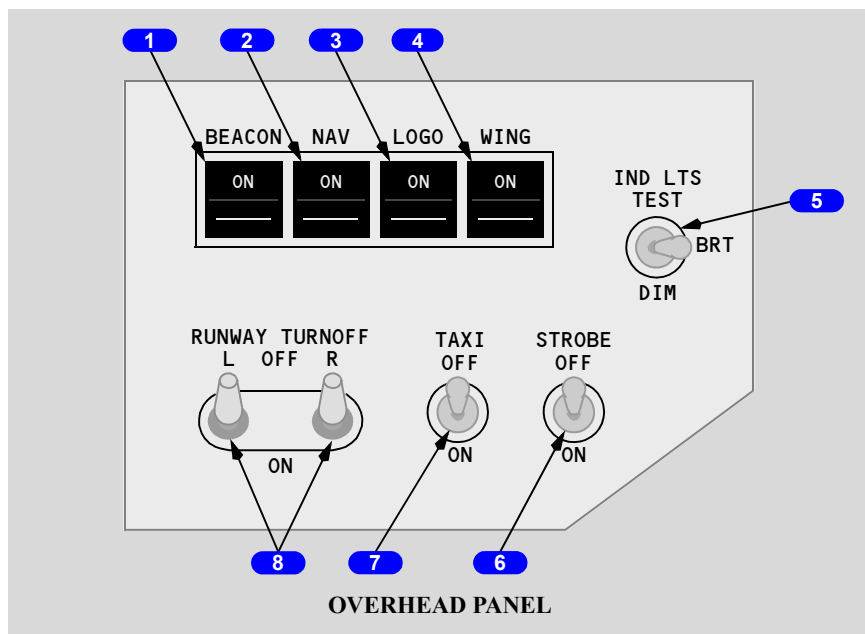
11 LANDING Light Switches

OFF – the landing light is not illuminated.

ON – the landing light is illuminated.

Note: The nose gear landing lights cannot illuminate when the nose landing gear is not down and locked.

Lighting Panel



1 BEACON Light Switch

ON – the red anticollision beacon lights on the top and bottom of the fuselage operate.

2 Navigation (NAV) Light Switch

ON – the red, green, and white navigation position lights are illuminated.

3 LOGO Light Switch

ON – the stabilizer-mounted logo lights illuminate the airline logo on the vertical tail surface.

4 WING Light Switch

ON – the wing leading edge illumination lights are illuminated.

5 Indicator Lights (IND LTS) Switch

TEST (spring-loaded):

- illuminates all annunciator lights to full brightness for 10 seconds to check the bulbs, then dims the lights as long as the switch is held
- causes test patterns to display on the stabilizer position indicators, rudder trim indicator, and radio tuning panel displays.

BRT – sets all illuminated annunciator lights to full brightness.

DIM – sets all illuminated annunciator lights to low brightness.

6 STROBE Light Switch

OFF – the white anticollision strobe lights on the tips of each wing and the tailcone are off.

ON – the strobe lights operate.

7 TAXI Light Switch

OFF – the taxi lights are extinguished.

ON – the taxi lights are illuminated.

Note: The taxi lights do not illuminate when the nose landing gear is not down and locked

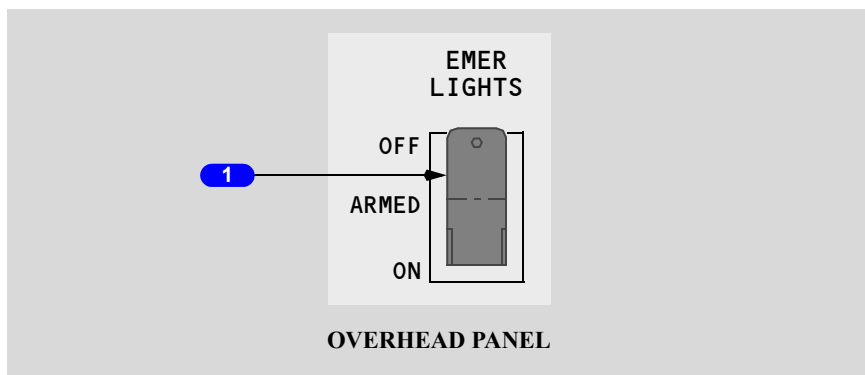
8 RUNWAY TURNOFF Light Switches

OFF – the runway turnoff light is extinguished.

ON – the runway turnoff light is illuminated.

Miscellaneous Lighting Controls

Flight Deck Emergency Lights Switch



1 Emergency (EMER) LIGHTS Switch

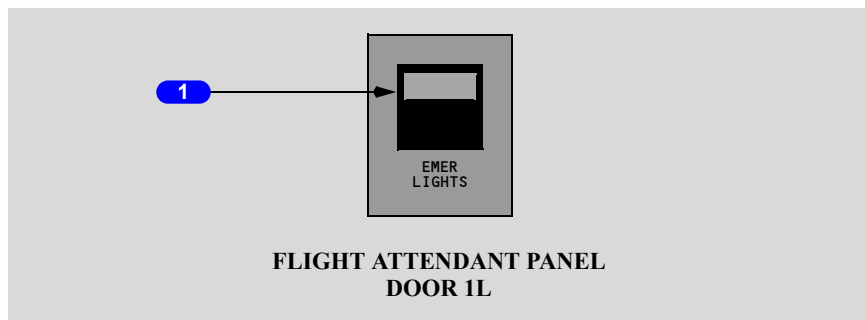
OFF – prevents emergency lights system operation if airplane electrical power fails or is turned off.

ARMED – all emergency lights illuminate automatically if airplane electrical power fails or is turned off.

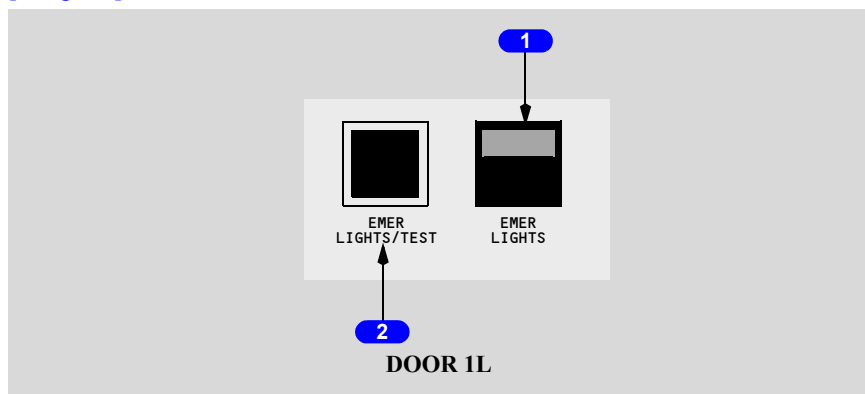
ON – all emergency lights illuminate.

Cabin Emergency Lights Switch

[Passenger Option – Door 1L Shown, 2L Optional]



[Freighter]



1 Cabin Emergency (EMER) LIGHTS Switch

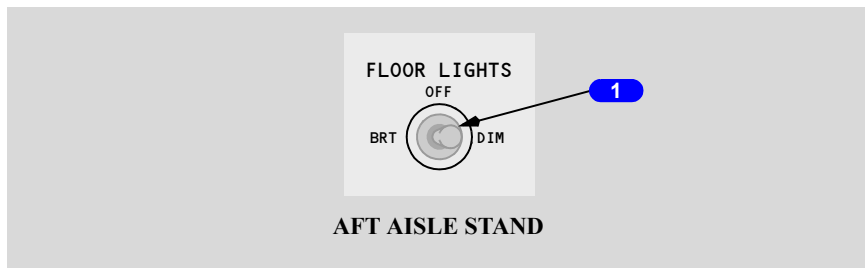
Push –

- Illuminated (red):
 - all cabin and exterior emergency lights illuminate
 - bypasses the flight deck emergency lights switch
- Extinguished: all cabin and exterior emergency lights extinguish.

2 EMER LIGHTS/TEST

Push – Illuminates emergency lights and exit signs for 1 minute

Floor Lights Switch



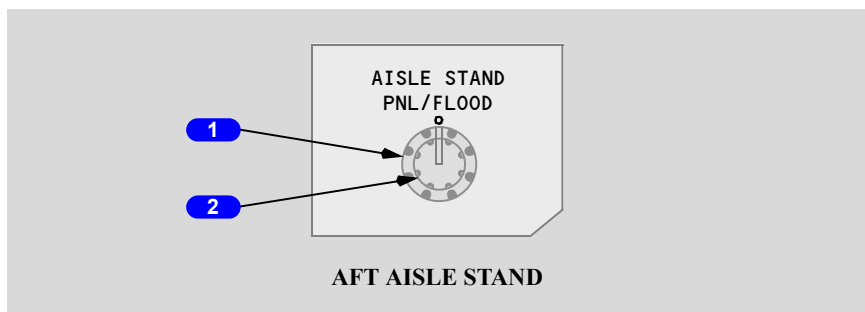
1 FLOOR LIGHTS Switch

OFF – the flight deck floor lights are not illuminated.

BRT – the floor lights are illuminated bright.

DIM – the floor lights are illuminated dim.

Aisle Stand Panel/Flood Light Control



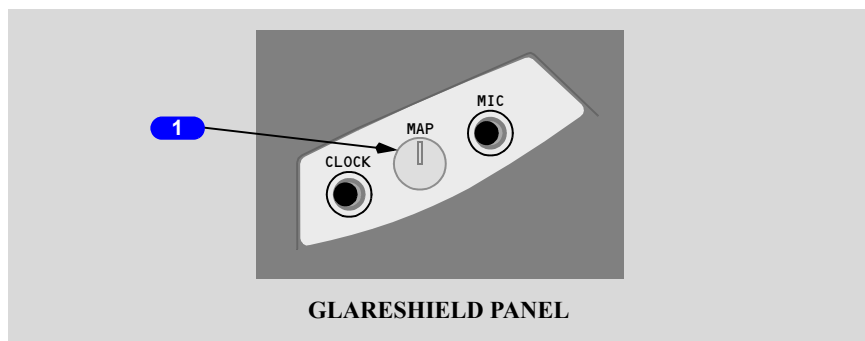
1 AISLE STAND Panel (PNL) Light Control (outer)

Rotate – controls the aisle stand instrument panel light brightness.

2 AISLE STAND FLOOD Light Control (inner)

Rotate – controls the aisle stand flood light brightness.

Map Light Control



1 MAP Light Control

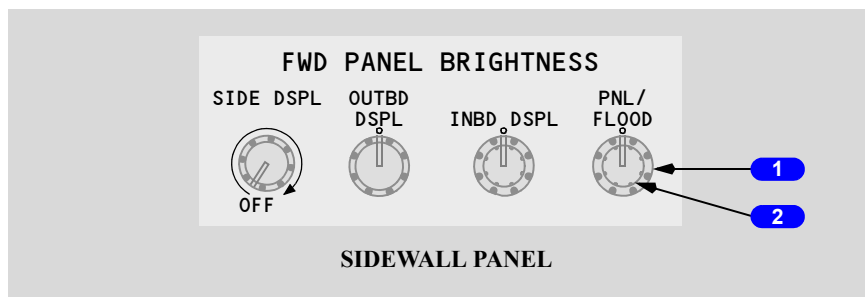
Pull – on.

Push – off.

Rotate – adjusts map light brightness.

Forward Panel Brightness Controls

Note: The display and weather radar brightness controls are described in Chapter 10, Flight Instruments, Displays.



1 FORWARD PANEL Light Control (outer)

Rotate – Controls forward panel lights brightness.

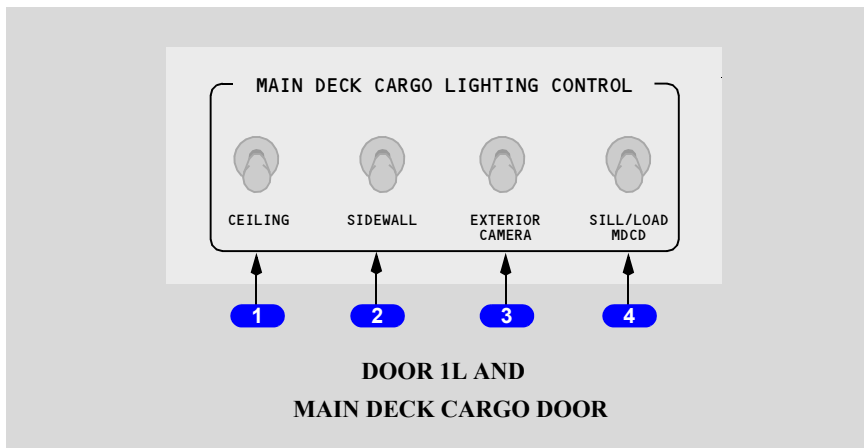
2 FORWARD PANEL FLOOD Light Control (inner)

Rotate – Controls forward panel flood light brightness.

Main Deck Cargo Lighting Control

[Freighter]

Lights are turned on and off by moving either switch up or down.



1 CEILING

Illuminates the ceiling lights in the main deck cargo area.

2 SIDEWALL

Illuminates the sidewall lights in the main deck cargo area.

3 EXTERIOR CAMERA

Illuminates the area outside of the main deck cargo door.

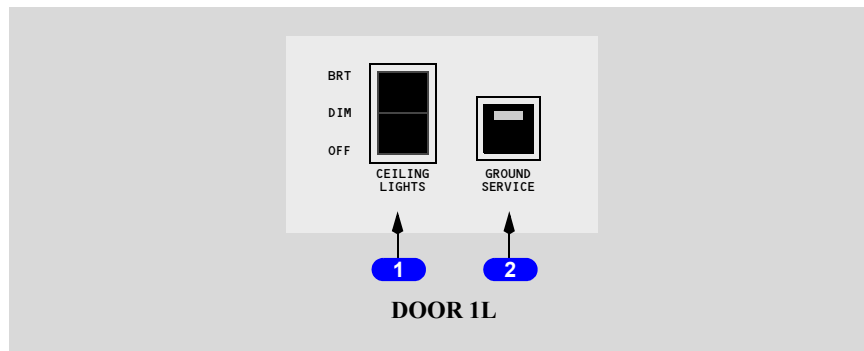
4 SILL/LOAD Main Deck Cargo Door (MDCD)

Turns off the main deck cargo door SILL/LOAD lights when the door is not closed.

Note: The load/sill lights automatically illuminate when the door is not closed.

Supernumerary Lighting Control

[Freighter]



1 CEILING LIGHTS

BRT – the ceiling lights in the supernumerary area are illuminated bright.

DIM – the ceiling lights in the supernumerary area are illuminated dim.

OFF – the ceiling lights in the supernumerary area are not illuminated.

2 GROUND SERVICE

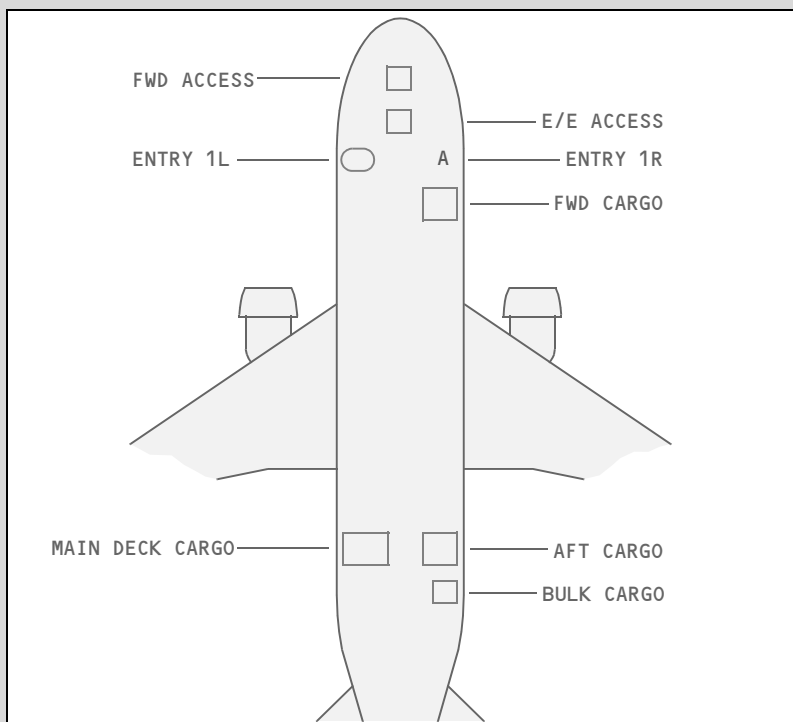
Push – Powers the Ground Service and Ground Handling electrical buses.

Doors and Windows

Door Synoptic Display

The doors synoptic is displayed by pushing the DOOR synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

[Option - With Door Arming Annunciators]
[Freighter]



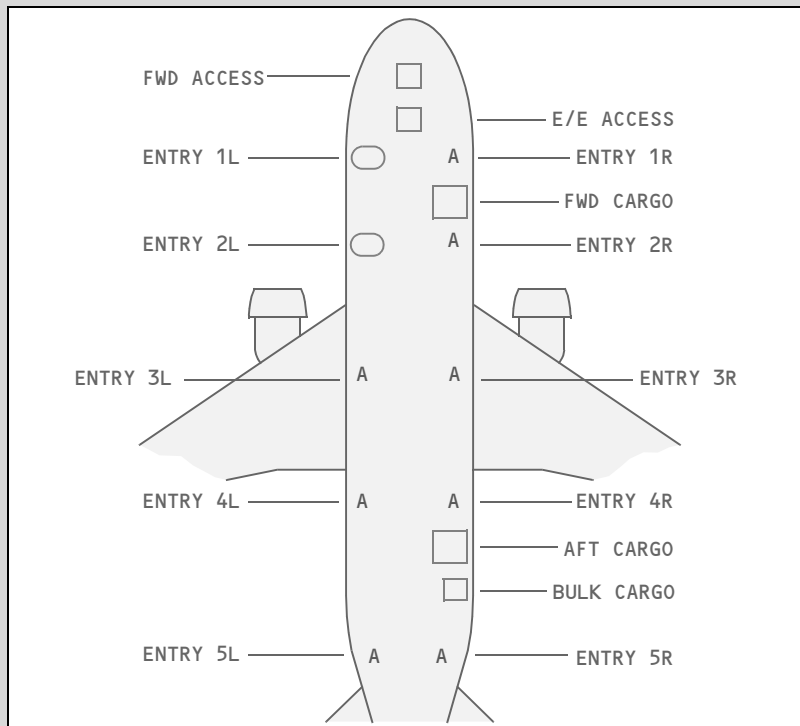
A (green) – Door mode is automatic (armed)
M (white) – Door mode is manual (disarmed)
(blank) – Door mode is not available

○ (amber) – passenger door open
(blank) – passenger door closed
○ (white) – door status is not available
□ (amber) – cargo/access door open
(blank) – cargo/access door closed
□ (white) – door status is not available

MULTIFUNCTION DISPLAY

[Option – With Door Arming Annunciations]

[Passenger. 777-300 shown. 777-200 similar]

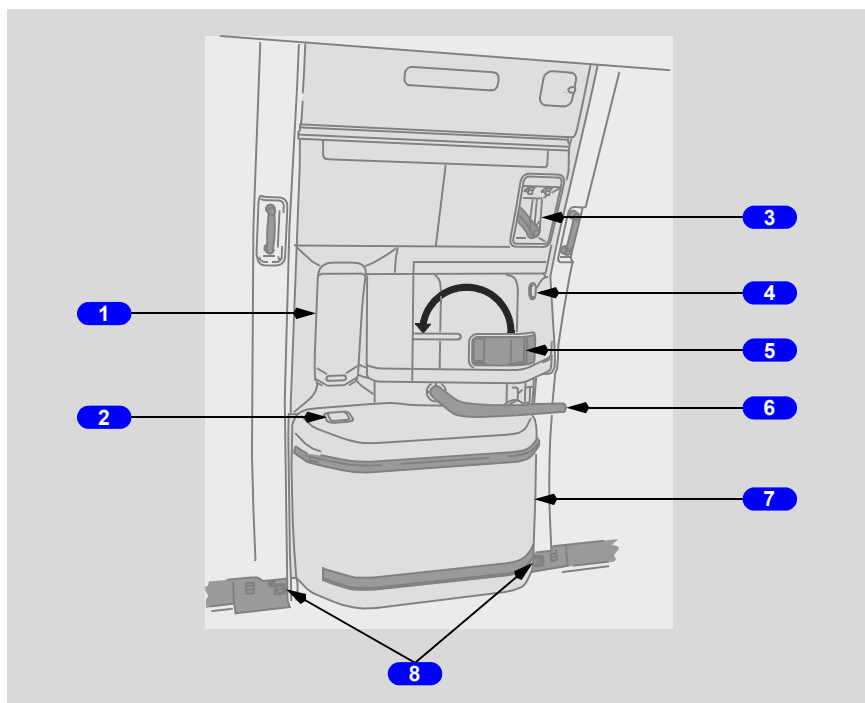


A (green) – Door mode is armed
M (white) – Door mode is manual.
(blank) - Door mode is not available

○ (amber) – passenger door open
(blank) – passenger door closed
○ (white) – door status is not available
□ (amber) – cargo/access door open
(blank) – cargo/access door closed
□ (white) – door status is not available

MULTIFUNCTION DISPLAY

Entry Door



1 Viewing Window

Allows observation outside the airplane.

2 Slide/Raft Gas Bottle Pressure Gage

Maintenance use only.

3 Door Mode Select Panel

See door mode select panel section.

4 Power Assist Reservoir Pressure Gage

If the gage needle is outside the green zone, the system is unusable.

5 Gust Lock Release Lever

Grab and pull inward to close the door.

6 Door Operating Handle

To open the door – rotate in the direction of the arrow.

To close the door – rotate in the opposite direction of the arrow.

7 Slide/Raft

The bustle contains the slide/raft.

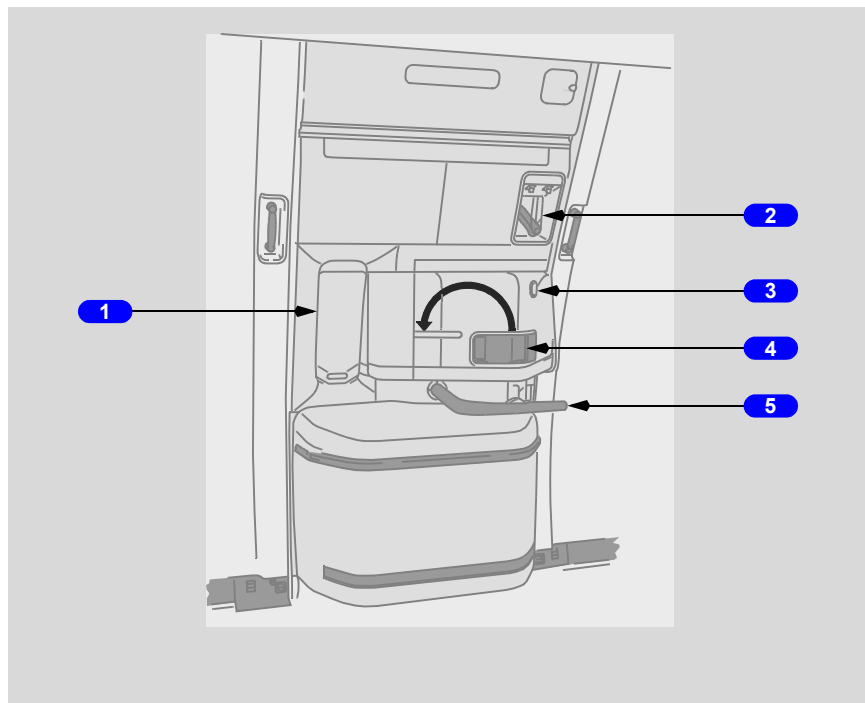
8 Girt Bar Indicator Flag Viewing Windows

Yellow in view – door and slide/raft are armed.

Black in view – door and slide/raft are not armed.

Overwing Emergency Exit Door

[777-300 and 777-300ER]



1 Viewing Window

Allows observation outside the airplane.

2 Door Mode Select Panel

See door mode select panel section.

3 Power Assist Reservoir Pressure Gage

If the gage needle is outside the green zone, the system is unusable.

4 Gust Lock Release Lever

Grab and pull inward to close the door.

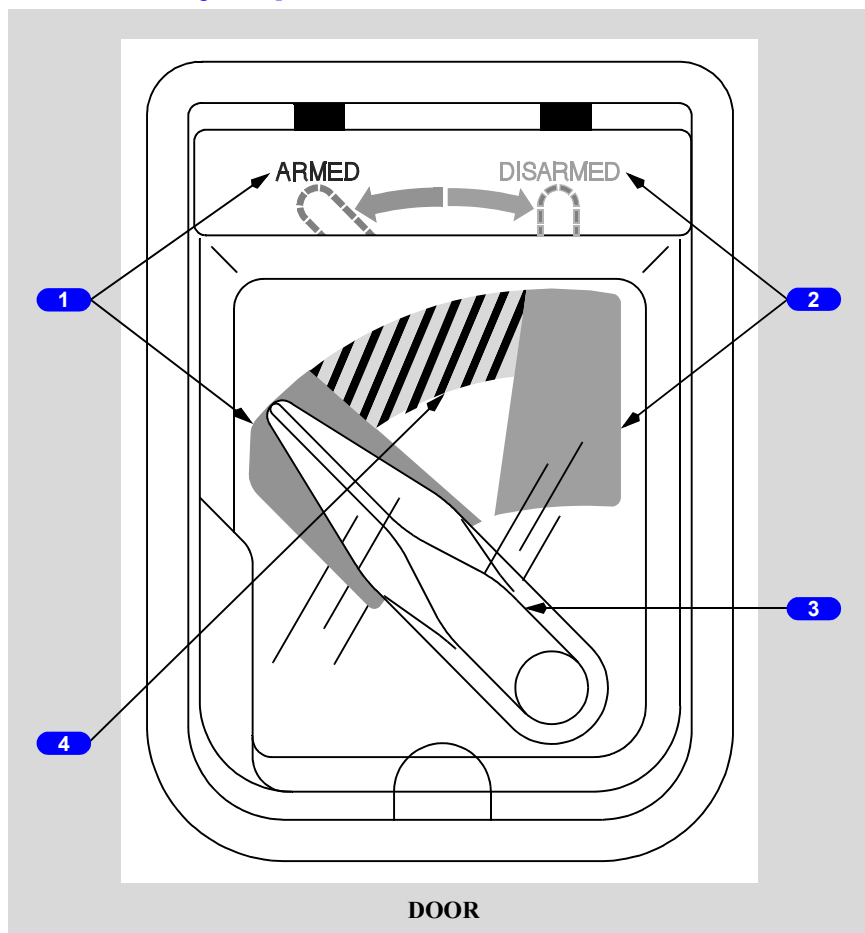
5 Door Operating Handle

To open the door – rotate in the direction of the arrow.

To close the door – rotate in the opposite direction of the arrow.

Door Mode Select Panel

[Option - ARMED/DISARMED shown, AUTOMATIC/MANUAL or
FLIGHT/PARK optional]



1 ARMED

Red.

Door is armed if the mode select lever is in the middle of the red band.

Note: If the door is opened from the outside, the mode select lever automatically moves to the DISARMED position.

2 DISARMED

Green.

Door is disarmed if the mode select lever is in the middle of the green band.

3 Door Mode Select Lever

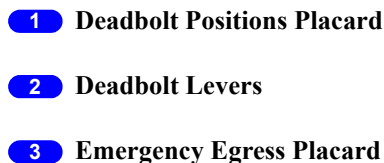
Used to select the required mode for flight, ARMED, or arrival, DISARMED.

4 Unsafe Band

If the mode select lever is anywhere in the unsafe band, the door may be either armed or disarmed.

CAUTION: To ensure that the door is properly armed or disarmed, the door mode selector must be positioned in the middle of the red or green band.

[Option - Flight deck security door]
[Passenger]



Describes how to separate lower break-away panel from a jammed door to allow door opening and egress

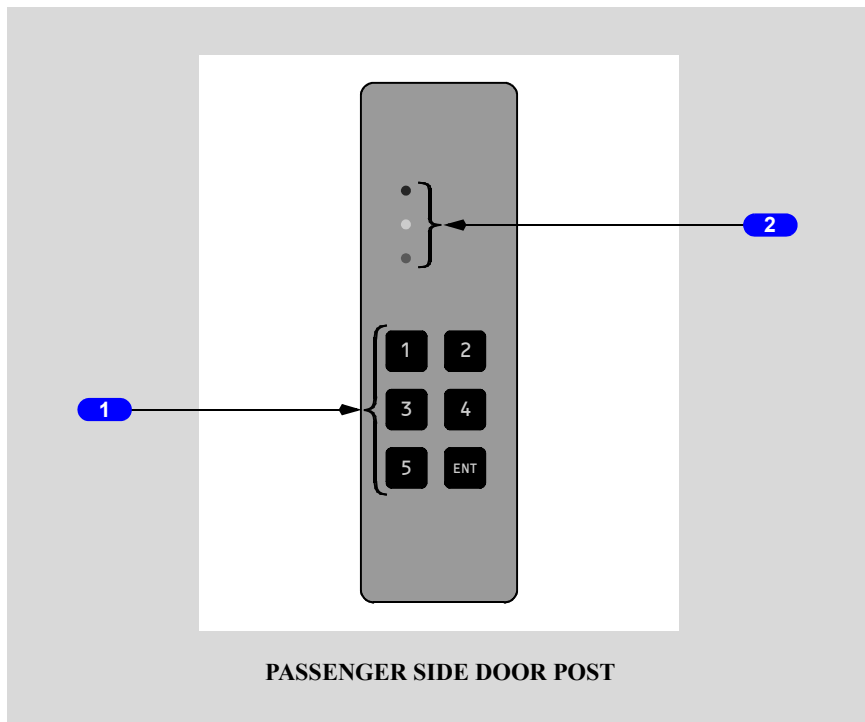
4 Shear Pins

Retract out of lower break-away panel when shear pin levers rotate down.

5 Security Grill

Prevents intrusion into flight deck if decompression panels open due to cabin depressurization.

Flight Deck Emergency Access Panel



1 Keypad

Push - enters 3 to 8 digit emergency access code by pressing numeric then "ENT" keys. Entry of correct emergency access code sounds flight deck chime.

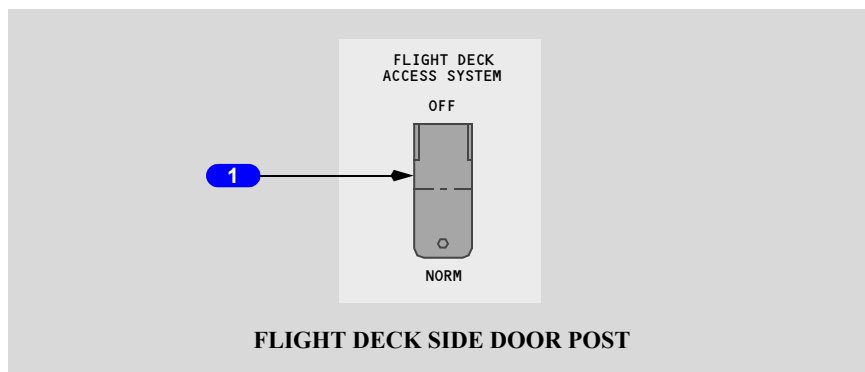
2 Access Lights

Illuminated (red) - door locked or Flight Deck Access System switch OFF.

Illuminated (amber) - correct emergency access code entered.

Illuminated (green) - door unlocked.

Flight Deck Access System Switch

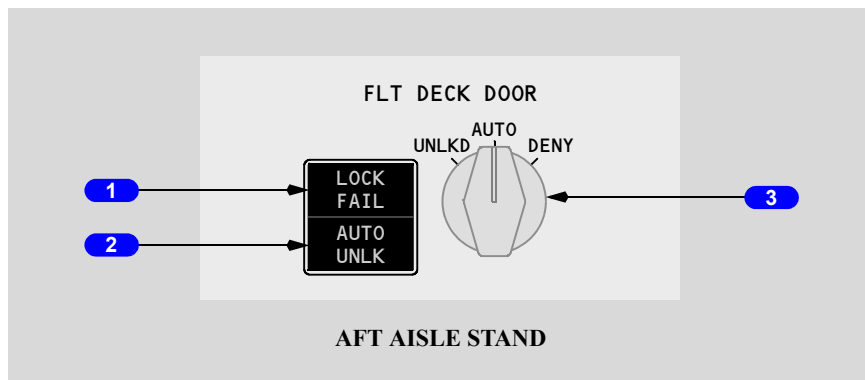


1 Flight Deck Access System Switch

OFF - removes electrical power from door lock.

NORM (Normal) - flight deck access system configured for flight.

Flight Deck Door Lock Panel



1 LOCK FAIL Light

Illuminated (amber) - Flight Deck Door Lock selector in AUTO and door lock has failed or Flight Deck Access System switch in OFF.

2 AUTO Unlock (UNLK) Light

Illuminated (amber) - correct emergency access code entered in keypad. AUTO UNLK light flashes and continuous chime sounds before timer expires and door unlocks.

3 Flight (FLT) Deck Door Lock Selector

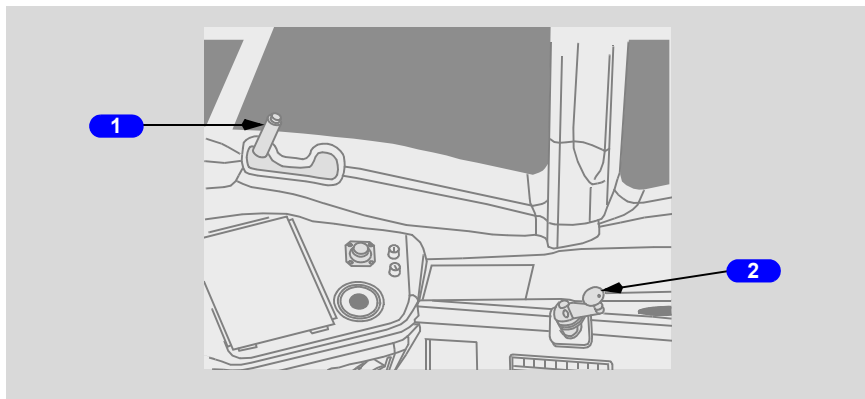
Spring loaded to AUTO. Selector must be pushed in to rotate from AUTO to UNLKD. Selector must not be pushed in to rotate from AUTO to DENY.

UNLKD - door unlocked while selector in UNLKD.

AUTO - door locked. Allows door to unlock after entry of emergency access code and expiration of timer, unless crew takes action.

DENY - rejects keypad entry request and prevents further emergency access code entry for a time period.

Flight Deck Number Two Window



1 Window Lock Lever

Forward – with the window fully closed, locks the window. If the lock lever is properly locked, the orange indicator is not visible below the release button. The EICAS message WINDOW FLT DECK L, R displays if a window is not properly latched.

Aft – unlocks the window so it can be cranked open.

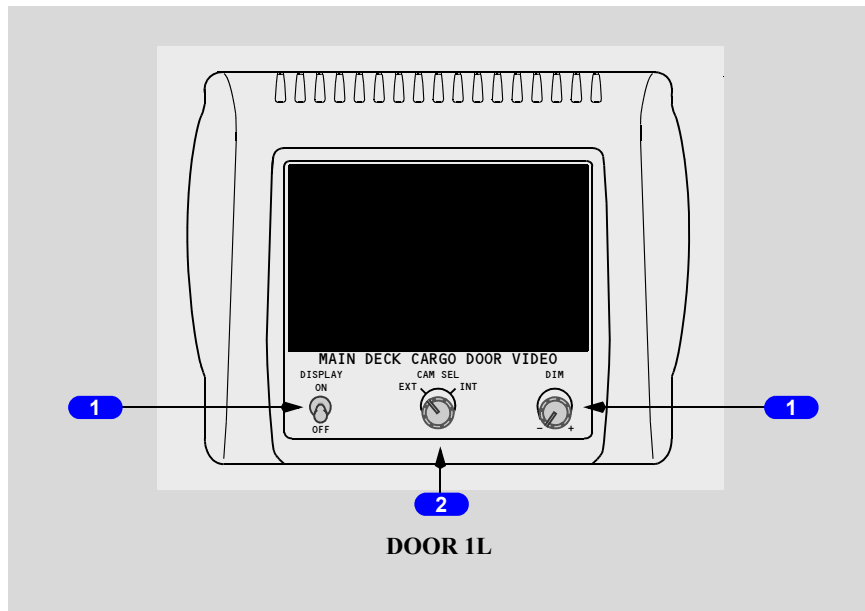
2 Window Crank

Used to position the window open or closed when the window lock lever is unlocked.

To reposition the window crank without moving the window, push and hold the button in the center of the window crank.

Main Deck Cargo Door Video

[Freighter]



1 Display

ON – the video display is on.

OFF – the video display is off.

2 Cam Sel (Camera Select)

EXT (exterior) – the video from the exterior camera is displayed.

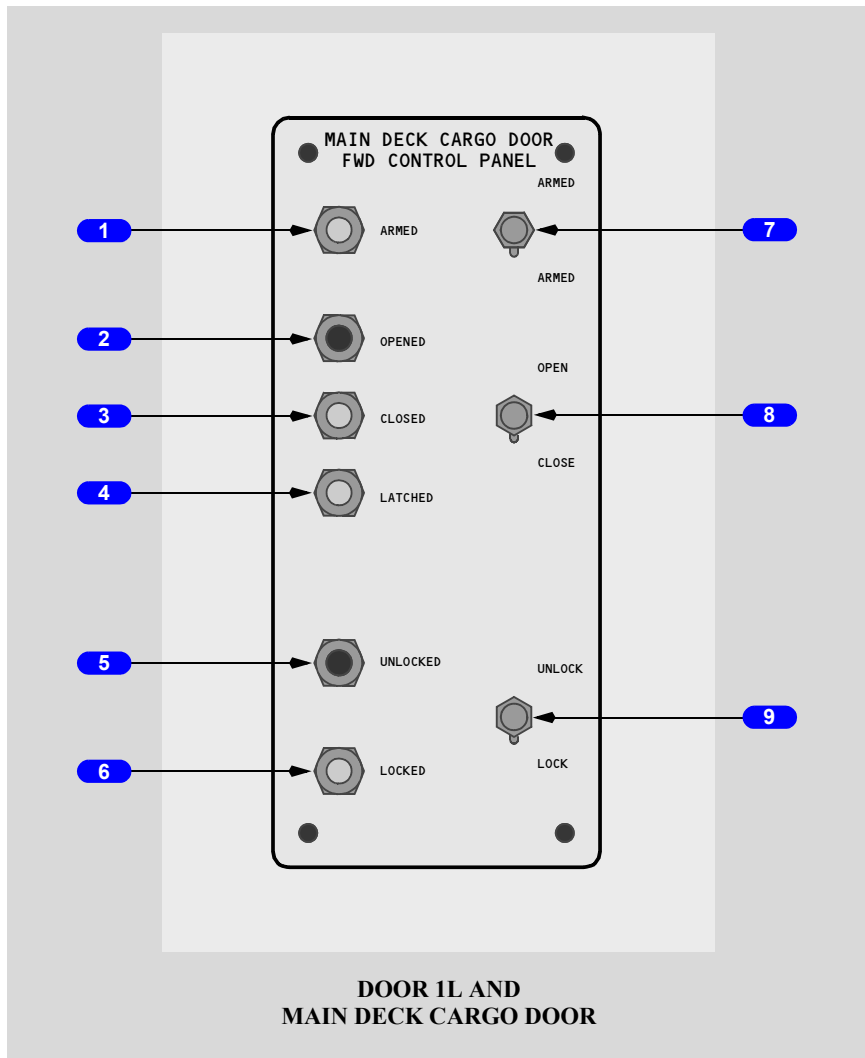
INT (interior) – the video from the interior camera is displayed.

3 Dim

Rotate – controls display brightness.

Main Deck Cargo Door Controls

[Freighter]



1 ARMED Light

Illuminated (amber) – cargo door unlocked and electrical power available.

2 OPENED Light

Illuminated (blue) – cargo door fully open.

3 CLOSED Light

Illuminated (green) – cargo door fully closed.

4 LATCHED Light

Illuminated (green) – cargo door latched.

5 UNLOCKED Light

Illuminated (blue) – cargo door unlocked.

6 LOCKED Light

Illuminated (green) – cargo door locked.

7 ARMED/ARMED Switch

ARMED (push up and hold) – arms cargo door for opening.

ARMED (push down and hold) – arms cargo door for closing.

8 OPEN/CLOSE Switch

OPEN – opens cargo door when armed.

CLOSE – closes cargo door when armed.

9 UNLOCK/LOCK Switch

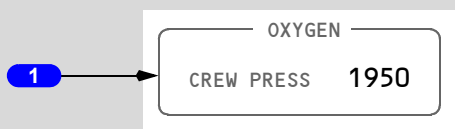
UNLOCK – unlocks cargo door.

LOCK – locks cargo door.

Oxygen Systems

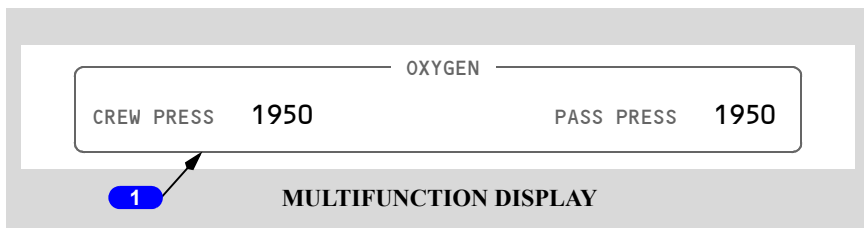
Oxygen Indications

[Passenger Option – Chemical Passenger Oxygen]

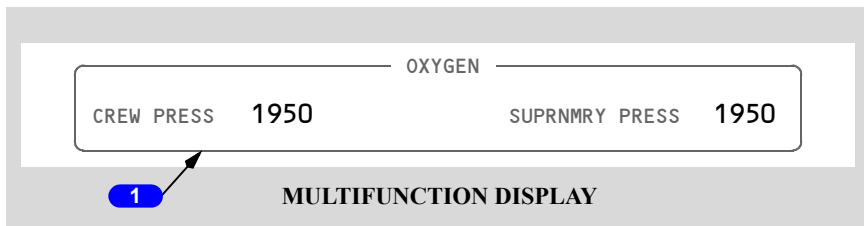


MULTIFUNCTION DISPLAY

[Passenger Option – Gaseous Passenger Oxygen]



[Freighter Basic – Gaseous Supernumerary Oxygen]



1 Oxygen Pressure Display

[Passenger Option – Chemical Passenger Oxygen]

Displays crew oxygen cylinder pressure (PSI).

[Passenger Option – Gaseous Passenger Oxygen]

Displays crew and passenger oxygen cylinder pressure (PSI).

[Freighter Basic – Gaseous Supernumerary Oxygen]

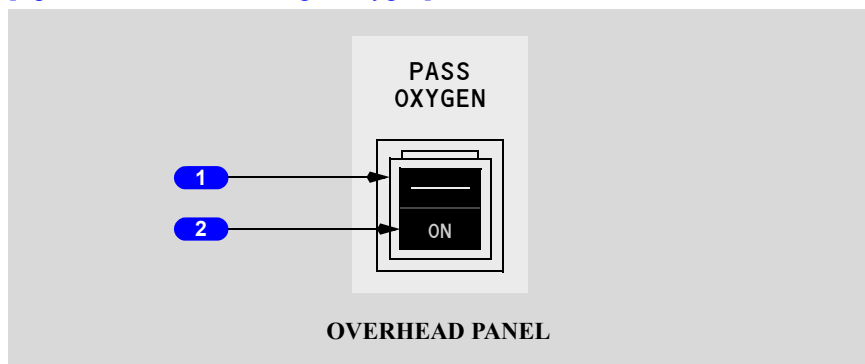
Displays crew and supernumerary oxygen cylinder pressure (PSI).

Note: Access is through the display select panel STATUS switch.

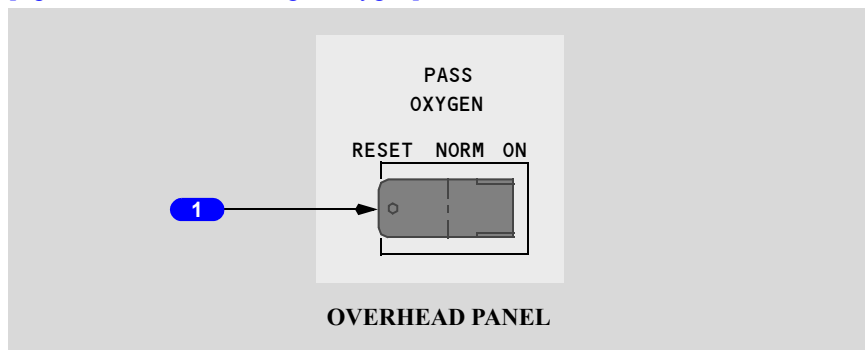
Passenger Oxygen Switch

[Passenger]

[Option – Chemical Passenger Oxygen]



[Option – Gaseous Passenger Oxygen]



1 PASSENGER OXYGEN Switch

[Option – Chemical Passenger Oxygen]

Push – the cabin oxygen masks drop.

1 PASSENGER OXYGEN Switch

[Option – Gaseous Passenger Oxygen]

RESET (spring-loaded) – flow control units close if cabin altitude is below 13,500 feet.

NORM – system automatically activates when cabin altitude reaches approximately 13,500 feet.

ON (spring-loaded) – system activates and cabin oxygen masks drop.

2 Passenger Oxygen ON Light

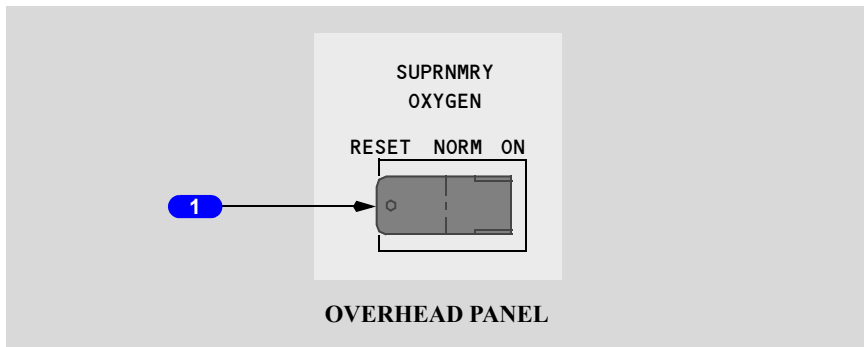
[Option – Chemical Passenger Oxygen]

Illuminated (amber) – The passenger oxygen system is operating and the masks have dropped.

Supernumerary Oxygen Switch

[Freighter]

[Basic – Gaseous Supernumerary Oxygen]



1 Supernumerary (SUPRNMRY) OXYGEN Switch

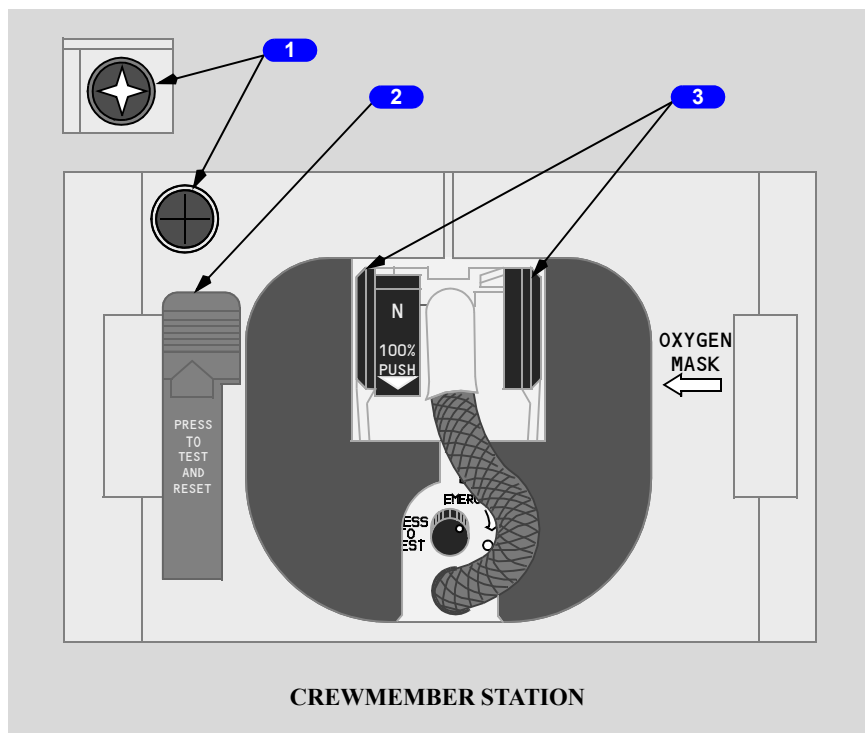
[Basic – Gaseous Supernumerary Oxygen]

RESET (spring-loaded) – flow control units close if cabin altitude is below 13,500 feet.

NORM – system activates when cabin altitude reaches approximately 13,500 feet.

ON (spring-loaded) – system activates and cabin oxygen masks drop.

Oxygen Mask Panel



1 Oxygen Flow Indicator

Shows a yellow cross when oxygen is flowing.

2 RESET/TEST Switch

Push –

- with the left oxygen panel door closed and the OXY ON not displayed, turns oxygen on momentarily to test the regulator
- with the left oxygen panel door closed and the OXY ON flag displayed:
 - turns oxygen off and deactivates the mask microphone
 - reactivates the boom microphone.

3 Oxygen Mask Release Levers

Squeeze and pull –

- unlocks the oxygen panel doors
- releases the mask
- oxygen turns on when the oxygen panel doors open

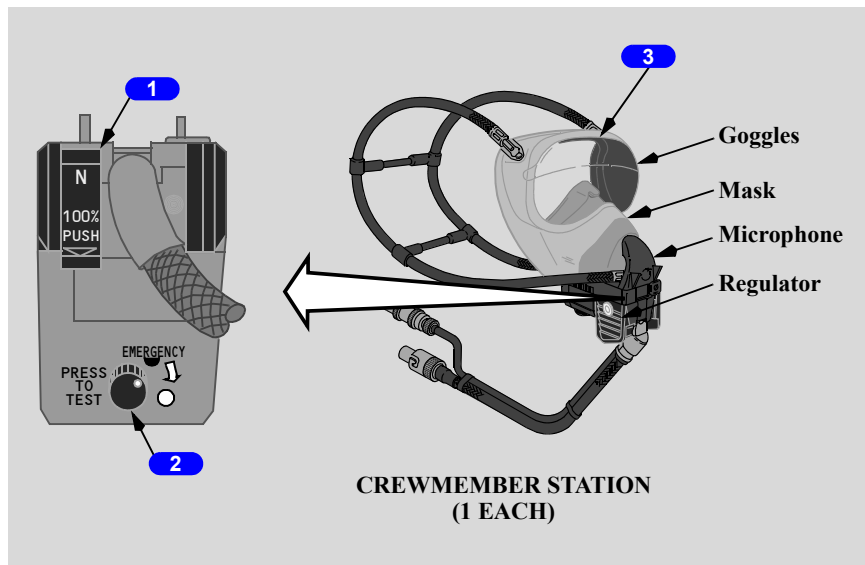
- automatically selects the mask microphone when the left oxygen panel door is opened
- disables the boom microphone.

Squeeze (right lever) – inflates the mask harness.

Release – deflates the mask harness into position on the head and face.

Oxygen Mask and Regulator

[Option – Built-In Goggles with Protective Strip.]



1 NORMAL/100% Switch

N – supplies an air/oxygen mixture on demand (the ratio depends on cabin altitude).

100% – supplies 100% oxygen on demand (not an air/oxygen mixture).

2 Oxygen Mask Emergency/Test Selector

Normal (non-emergency) position - supplies air/oxygen mixture or 100% oxygen on demand, depending upon the position of the Normal/100% switch.

Automatically supplies 100% oxygen under positive pressure when cabin altitude is above a preset value.

EMERGENCY position (rotate in the direction of the arrow) – supplies 100% oxygen under positive pressure at all cabin altitudes (protects against smoke and harmful vapors).

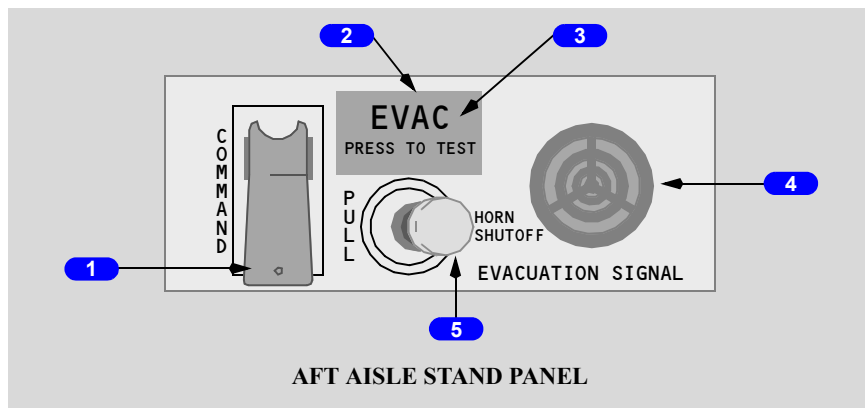
PRESS TO TEST— tests the positive pressure supply to the regulator.

3 Protective Strip

There is a protective strip of clear plastic on the top portion of the lens. This strip can be peeled off using the tab on the right side in case of icing caused by a rapid depressurization.

Emergency Evacuation Panel

[Typical]



1 Evacuation COMMAND Switch

ON –

- the red EVAC light (flight deck) and amber EVAC lights (flight attendant panels) flash
- an audio horn sounds at each panel.

OFF (guarded position) - the evacuation signals can be activated at the flight attendant panels.

2 Evacuation (EVAC) PRESS TO TEST Switch

Push – tests the EVAC light.

3 Evacuation (EVAC) Light

Illuminated (red) – a command switch is in the ON position.

4 EVACUATION SIGNAL Horn

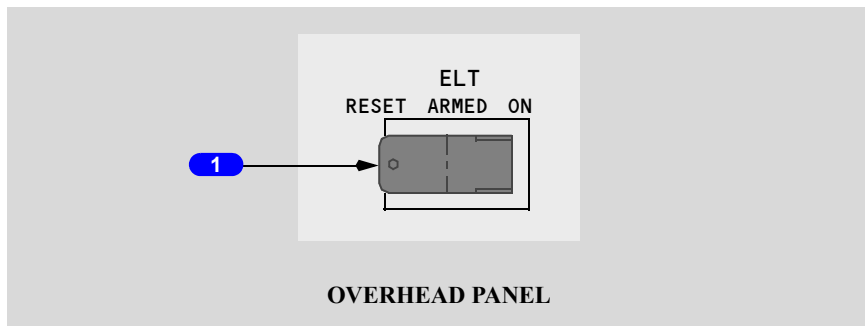
Sounds an audio signal.

5 Evacuation HORN SHUTOFF Switch

PULL – Silences the flight deck evacuation signal horn.

Fuselage Mounted Emergency Locator Transmitter

[Option]



1 Emergency Locator Transmitter (ELT) Switch

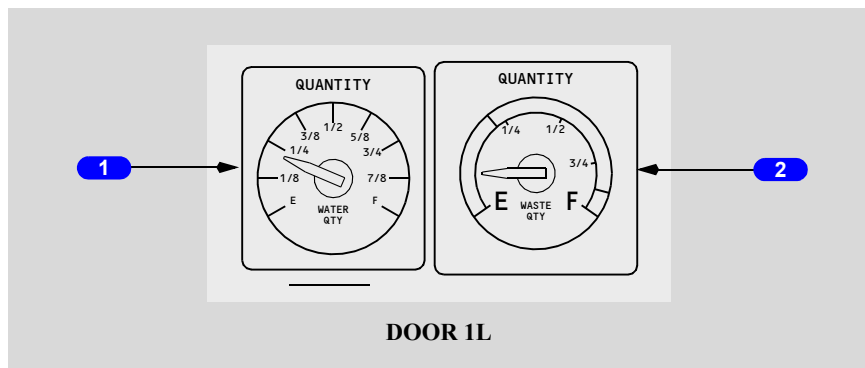
RESET (spring-loaded) – ends transmission of emergency locator signal.

ARMED (guarded position) – transmits emergency locator signal if activated by high deceleration forces.

ON – transmits emergency locator signal.

Water and Waste Indicators

[Freighter]



1 WATER QTY

Total water quantity in fractions.

2 WASTE QTY

Total waste quantity in fractions.

Airplane General, Emergency Equipment, Doors, Windows Systems Description

Chapter 1

Section 40

Introduction

This section describes miscellaneous airplane systems, including:

- lighting systems
- oxygen systems

Lighting Systems

Lighting systems described in this section include:

- exterior lighting
 - flight deck lighting
- [Passenger]
- cabin lighting
- [Freighter]
- main deck lighting
 - emergency lighting.

Exterior Lighting

Exterior lighting consists of these lights:

- landing
- runway turnoff
- taxi
- strobe
- beacon
- navigation (position)
- logo
- wing leading edge illumination
- escape slide emergency lights.

Landing Lights

The landing lights consist of the left, right, and nose gear landing lights. The left and right landing lights are located in the left and right wing root. These lights are optimized for flare and ground roll. The two nose gear–located landing lights are optimized for approach.

Runway Turnoff Lights

Runway turnoff lights are installed in the left and right wing roots. The lights illuminate the area in front of the main gear.

Taxi Lights

Taxi lights are installed on the non–steerable portion of the nose strut. They are inoperative when the nose landing gear is not down and locked.

Strobe Lights

The strobe lights are white anticollision strobe lights located on each forward wing tip and on the tailcone.

Beacon Lights

The beacon lights are red anticollision strobe lights located on the top and bottom of the fuselage.

Navigation Lights

The navigation lights are the standard red (left forward wingtip), green (right forward wingtip), and white (aft tip of both wings and tailcone) position lights.

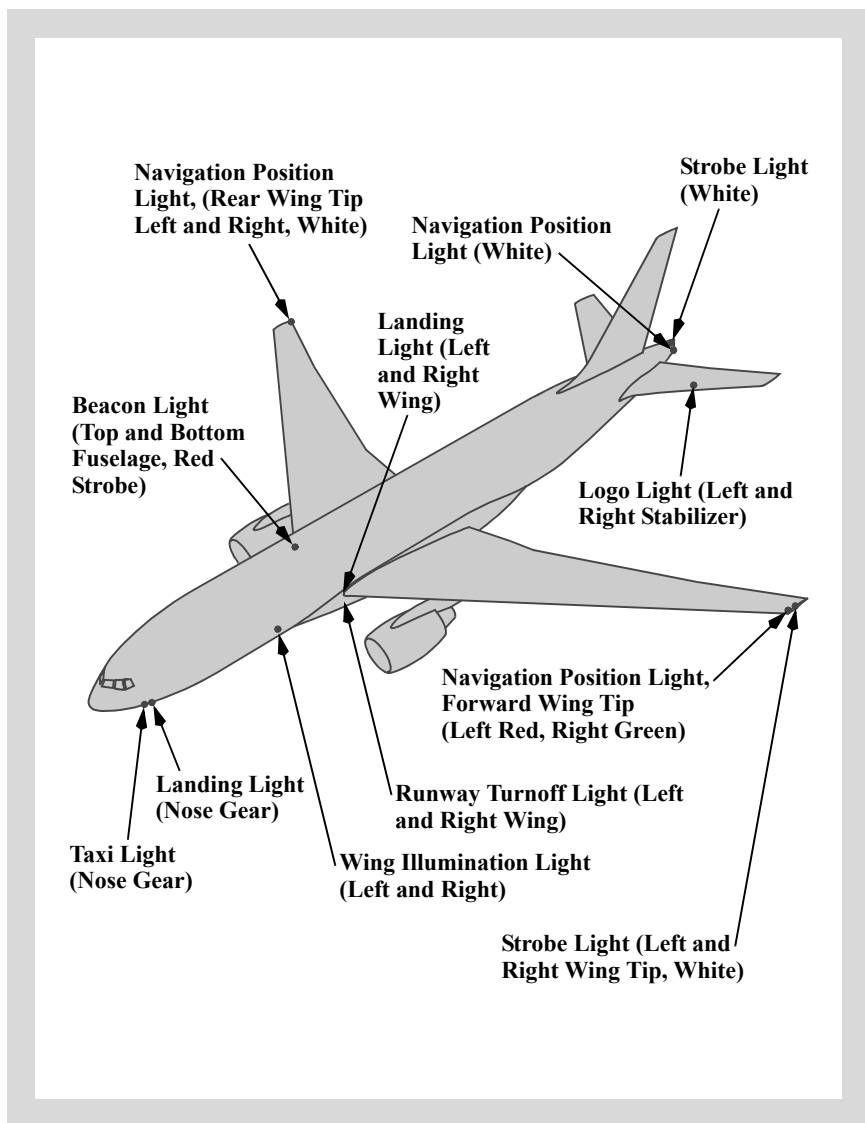
Logo Lights

Logo lights are located on the stabilizer to illuminate the airline logo on the vertical tail surface.

Wing Lights

Wing lights are installed on the fuselage and illuminate the leading edge of the wing.

Exterior Lighting Locations



Flight Deck Lighting

Flight deck lighting is provided for panel illumination, area lighting and localized illumination. Flood lights and light plates provide panel illumination. Dome lights provide flight deck area lighting. Map lights and a single utility light provide localized illumination.

Panel and flood lights illuminate the forward panels, glareshield and aisle stand panels. When the storm light switch is on, the left and right forward panel flood lights, glare shield flood lights, dome lights, aisle stand flood light, and all illuminated annunciator lights illuminate at full brightness.

If normal electrical power is lost, standby electrical power is automatically provided to the primary displays. The aisle stand, left and right forward panel and glareshield flood lights, and the dome lights illuminate automatically at a fixed brightness.

Master Brightness Control System

The MASTER BRIGHTNESS control provides the means of controlling panel and display lighting brightness with the use of one control. The control is turned on when the MASTER BRIGHTNESS switch is pushed on.

Lighting controlled through the master brightness system are:

- PFDs
- MFDs
- EICAS
- CDUs
- clocks
- standby instruments
- standby compass
- digital displays
- overhead panel
- glareshield panel
- forward panels (left, center, and right)

[Option – Side Panel Displays Shown]

- side panel displays
- aisle stand panels (forward and aft).

The individual lighting controls for the above displays and panels, except the CDUs and side displays, have a center detent position identified by a white dot at the mid-range adjustment position.

Individual controls can be used for dimming individual displays and panels. The individual controls have limited adjustment capability when the MASTER BRIGHTNESS switch is on, and should be centered in the detent when first adjusting the MASTER BRIGHTNESS control. They have full range of brightness control when the MASTER BRIGHTNESS switch is off.

Cabin Lighting

[Passenger]

Cabin lighting near the flight deck entry door is automatically dimmed or extinguished when the flight deck door is opened while an engine is operating. This reduces the light level entering the flight deck at night.

Cabin Signs

The cabin signs are controlled by overhead panel selectors. The cabin signs illuminate when the following conditions are satisfied:

FASTEN SEAT BELTS signs (AUTO selected):

- landing gear not up and locked, or
- flap lever not up, or
- airplane altitude below an airline defined altitude, or
- airplane altitude below 10,000, or
- cabin altitude above 10,000 feet, or

[Passenger]

- passenger oxygen on.

[Freighter]

- supernumerary oxygen on.

NO SMOKING signs (AUTO selected):

- landing gear not up and locked, or
- cabin altitude above 10,000 feet, or

[Passenger]

- passenger oxygen on.

[Freighter]

- supernumerary oxygen on.

All cabin signs can be controlled manually by positioning the respective switch to ON or OFF. When the SEAT BELTS and NO SMOKING selectors are in the OFF position, and oxygen is ON, the FASTEN SEAT BELTS and NO SMOKING signs illuminate.

RETURN TO SEAT signs are illuminated with the FASTEN SEAT BELTS signs, except when oxygen is deployed.

When the cabin signs illuminate or extinguish, a low tone sounds over the PA system.

Emergency Lighting

The emergency lighting system is powered by remote batteries. Battery charge is maintained by the airplane electrical system. A fully charged battery provides at least 15 minutes of operation.

[Passenger]

Emergency lighting is controlled by the EMERGENCY LIGHTS switch on the overhead panel. The switch can be used to manually activate or arm the system for automatic operation. Automatic operation occurs if DC power fails or is turned off when the system is armed. The emergency lighting system can also be controlled by the EMERGENCY LIGHTS switch on the main flight attendant switch panel.

[Freighter]

Emergency lighting is controlled by the EMERGENCY LIGHTS switch on the overhead panel. The switch can be used to manually activate or arm the system for automatic operation. Automatic operation occurs if DC power fails or is turned off when the system is armed. The emergency lighting system can also be controlled by the EMERGENCY LIGHTS switch at door 1L.

When the EMERGENCY LIGHTS switch in the flight deck is armed, and the door mode select lever is in the armed position, moving the door handle to the open position will cause the exterior fuselage light and the interior emergency lights at that door to illuminate.

The EICAS advisory message EMER LIGHTS is displayed if:

- the emergency lights switch is not in the ARMED position, or

[Passenger]

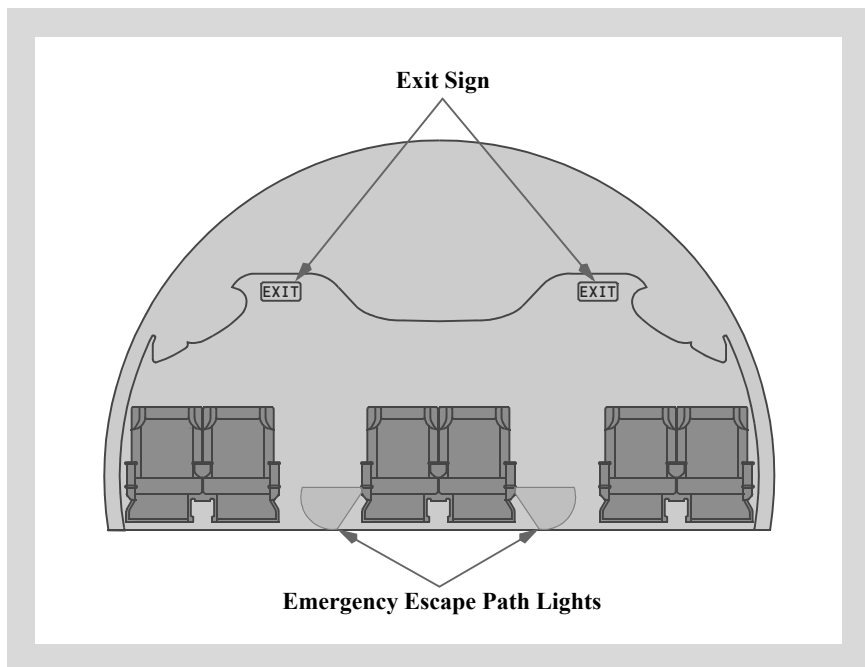
- the emergency lights switch is in the ARMED position, and the emergency lights are activated by the switch at a flight attendant panel.

[Freighter]

- the emergency lights switch is in the ARMED position, and the emergency lights are activated by the switch at door 1L.

Interior Emergency Lighting

[Passenger]



Interior emergency lighting consists of door, aisle, cross-aisle, escape path, exit lights, and luminescent exit signs.

Escape path lighting consists of lights installed in the arm rest of the center passenger seats, and on center galleys, lavatories, closets and partitions spaced at intervals in the aisles and cross-aisles. When illuminated, escape path lighting provides visual guidance for emergency evacuation if all sources of lighting more than four feet above the aisle floor are obscured by smoke.

Battery powered exit lights are located at each cabin exit.

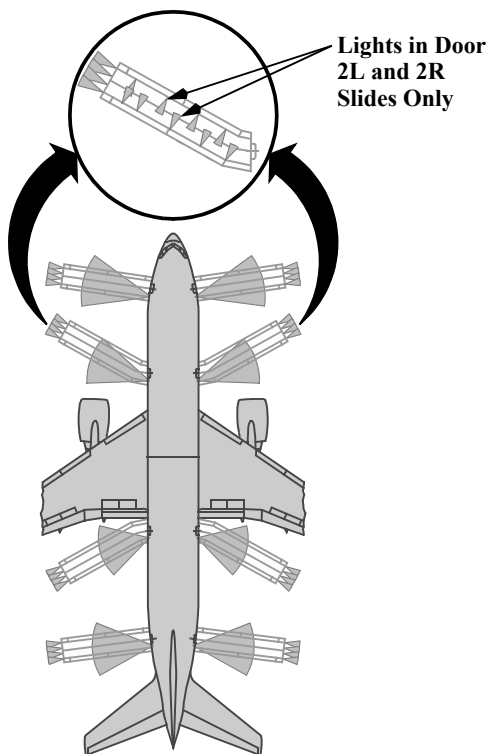
Interior Emergency Lighting

[Freighter]

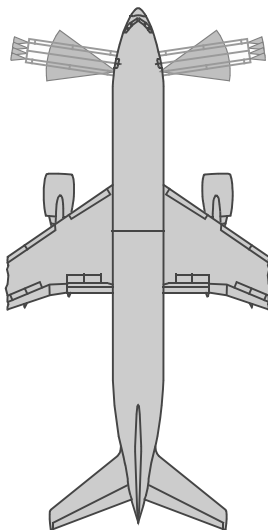
Interior emergency lighting consists of door, aisle, exit lights, and luminescent exit signs. Additional battery-powered exit identifier lights are located at each cabin exit.

Exterior Emergency Lighting

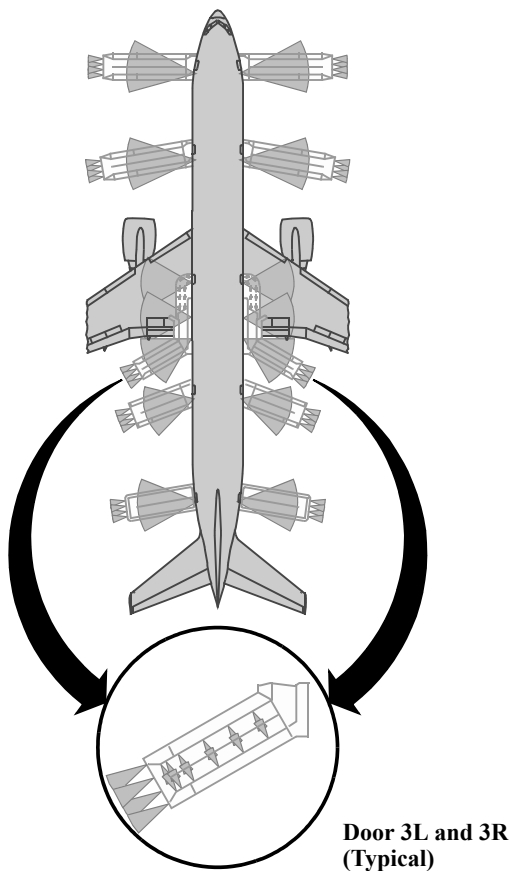
[777-200, 777-200ER, and 777-200LR]



[777F]



[777-300 and 777-300ER]



[777-200, 777-200ER, and 777-200LR]

Exterior emergency lighting consists of escape slide lights. The lights are located aft of each door and illuminate the areas at the base of the escape slides. The slides in doors 2L and 2R have lights built into the sliding lanes. When the slide is deployed, the lights turn on automatically to illuminate the slide lanes.

[777F]

Exterior emergency lighting consists of escape slide lights. The lights are located aft of each door and illuminate the areas at the base of the escape slides.

[777-300 and 777-300ER]

Exterior emergency lighting consists of escape slide lights. The lights are located aft of each door and illuminate the areas at the base of the escape slides. The slides in doors 3L and 3R have lights built into the sliding lanes. When the slide is deployed, the lights turn on automatically to illuminate the slide lanes.

[777-300 and 777-300ER]

The overwing exit lights are located aft of the door and illuminate the evacuation path to the escape slide. When the slide is deployed, the lights turn on automatically to illuminate the slide lanes.

Oxygen Systems

[Passenger]

Two independent oxygen systems are provided, one for the flight crew and one for the passengers. Portable oxygen cylinders are located throughout the airplane for emergency use.

[Freighter]

Two independent oxygen systems are provided, one for the flight crew and one for the supernumeraries. Portable oxygen cylinders are located throughout the airplane for emergency use.

Flight Crew Oxygen System

The flight crew oxygen system uses quick-donning masks and regulators located at each crew station. Oxygen pressure is displayed on the MFD STATUS display. The EICAS advisory message CREW OXYGEN LOW alerts the flight crew of a low oxygen pressure condition.

Flight crew and observer masks and regulators are installed in oxygen mask panels near each seat. Squeezing the red oxygen mask release levers releases the mask from stowage. Removing the mask:

- inflates the mask harness
- momentarily displays the yellow oxygen flow indicator
- selects the mask microphone in the removed mask (the boom microphone is deselected).

The boom microphone can be reselected by closing the left oxygen panel door and pushing and releasing the RESET/TEST switch. This also shuts off oxygen to the mask. The oxygen flow can be restored by opening the left oxygen panel door.

Crew Oxygen Mask Microphone Test

The oxygen mask microphone can be tested without removing it from the storage box.

- Select the FLIGHT interphone transmitter and set the speaker volume as desired.
- Push and hold a MIC switch on either the audio control panel or the glare shield
- Push both the oxygen mask RESET/TEST switch and EMERGENCY/TEST selector.

The sound of oxygen flowing is heard through the speaker, verifying microphone operation.

Passenger Oxygen System

[Passenger]

[Option – Chemical Passenger Oxygen, 12 or 22 minutes]

The passenger oxygen system is supplied by individual chemical oxygen generators. The oxygen system provides oxygen to the passenger, attendant stations, and lavatory service units. The passenger oxygen masks and chemical oxygen generators are located above the passenger seats in passenger service units (PSUs). Oxygen flows from a PSU generator when any mask hanging from that PSU is pulled. Oxygen is available for approximately 12 minutes. The masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet. The passenger masks can be manually deployed from the flight deck by pushing the overhead panel PASSENGER OXYGEN switch to the ON position.

[Option – Gaseous Passenger Oxygen]

The passenger oxygen system is supplied by bottled gaseous oxygen. The oxygen bottles provide oxygen to the passenger, attendant station, and lavatory service units. The passenger oxygen masks are located above the passenger seats in passenger service units (PSUs). The masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet. The passenger masks can be manually deployed from the flight deck by pushing the overhead panel PASSENGER OXYGEN switch to the ON position. Oxygen flow can be reset by selecting the PASSENGER OXYGEN switch to the RESET position.

[Option – Gaseous Passenger Oxygen]

Passenger oxygen pressure is displayed on the MFD STATUS display.

Supernumerary Oxygen System

[Freighter]

The supernumerary oxygen system is supplied by bottled gaseous oxygen. The oxygen bottles provide oxygen to the passenger and lavatory service units. The supernumerary oxygen masks are located above the passenger seats in passenger service units (PSUs). The masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet. The supernumerary masks can be manually deployed from the flight deck by pushing the overhead panel SUPRNMRY OXYGEN switch to the ON position. Oxygen flow can be reset by selecting the SUPRNMRY OXYGEN switch to the RESET position.

Supernumerary gaseous oxygen pressure is displayed on the MFD STATUS display.

Lower Crew Rest Compartment (LCR)

[Option]

The lower crew rest compartment oxygen system is a chemical oxygen generator system. The oxygen masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet.

Door 1 Upper Crew Rest Compartment

[Option]

The door 1 upper crew rest compartment oxygen system is a chemical oxygen generator system. The oxygen masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet.

The door 1 upper crew rest compartment oxygen system is supplied by bottled gaseous oxygen. The oxygen masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet.

Door 3 Upper Crew Rest Compartment

[Option]

The door 3 upper crew rest compartment oxygen system is a chemical oxygen generator system. The oxygen masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet.

The door 3 upper crew rest compartment oxygen system is supplied by bottled gaseous oxygen. The oxygen masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet.

Door 4 Upper Crew Rest Compartment

[Option]

The door 4 upper crew rest compartment oxygen system is a chemical oxygen generator system. The oxygen masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet.

The door 4 upper crew rest compartment oxygen system is supplied by bottled gaseous oxygen. The oxygen masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet.

Door 5 Upper Crew Rest Compartment

[Option]

The door 5 upper crew rest compartment oxygen system is a chemical oxygen generator system. The oxygen masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet.

The door 5 upper crew rest compartment oxygen system is supplied by bottled gaseous oxygen. The oxygen masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet.

**Airplane General, Emergency
Equipment, Doors, Windows
Emergency Equipment****Chapter 1****Section 45**

[Option shown: Flight Attendant evacuation switch - all doors; Option: Door 1L/2L only, flight deck notification only, not installed]

Emergency Equipment Overview

This section describes the emergency equipment located throughout the airplane, including:

- emergency evacuation signal system
- emergency locator transmitters (ELTs)
- fire extinguishers
- portable flight deck emergency equipment location
- portable passenger cabin emergency equipment location

Emergency Evacuation Signal System

The emergency evacuation signal system alerts the flight attendants to evacuate the passenger cabin. Evacuation command switches are located on the flight deck and at the flight attendant panels.

Placing the flight deck evacuation signal COMMAND switch to ON activates the evacuation signal on the flight deck and on the flight attendant panels.

With the flight deck evacuation signal COMMAND switch in the OFF (guard down) position, pressing an EVAC COMMAND switch on a flight attendant panel will activate the evacuation signals on the flight deck and on the flight attendant panels.

Emergency Locator Transmitter (ELT)

Passenger Cabin

[Option: ELTs in Passenger Cabin]

ELTs are installed in the passenger cabin, as shown in the Emergency Equipment Locations – Passenger Cabin diagram.

Freighter

[Typical]

Two emergency locator transmitters (ELTs) are located in the supernumerary area in stowage box forward of door 1R.

Fuselage Mounted Emergency Locator Transmitter (ELT)

[Option]

An emergency locator transmitter (ELT) is mounted to the top center of the fuselage in the passenger cabin area.

The ELT automatically transmits distress signals on 121.5 MHZ, 243 MHZ, and 406 MHZ if a high deceleration is sensed, or if the ELT switch is positioned to ON.

The EICAS alert message ELT ON is displayed if the transmitter is activated. The ELT can be deactivated by placing the ELT switch to RESET momentarily, then ARMED.

Miscellaneous Portable Emergency Equipment

Passenger Airplane

Portable emergency equipment is stowed at strategic locations throughout the airplane. See Emergency Equipment Location - Flight Deck and Emergency Equipment - Passenger Cabin below for specific location.

Freighter Airplane

Portable emergency equipment is stowed at strategic locations throughout the airplane. See Emergency Equipment Location - Flight Deck / Supernumerary Area / Main Deck below for specific location.

Fire Extinguishers

Halon and water fire extinguishers are located throughout the passenger cabin and on the flight deck.

Halon fire extinguishers are located on the flight deck and in the supernumerary area.

Halon Fire Extinguishers

Halon fire extinguishers contain a liquefied gas agent under pressure. The extinguisher pressure indicator shows three pressure ranges:

- acceptable
- recharge
- overcharged

A safety pin with a pull ring prevents accidental trigger movement. When released, the liquefied gas agent vaporizes and extinguishes the fire. The extinguisher is effective on all types of fires, but is used primarily on electrical, fuel, and grease fires.

Note: The directions for use of the fire extinguisher are printed on the extinguisher.

WARNING: If a halon fire extinguisher is to be discharged in the flight deck area, all flight crew members must wear oxygen masks and use 100% oxygen with emergency selected.

CAUTION: For electrical fires, remove the power source as soon as possible. Avoid discharging directly on persons due to possibility of suffocating effects. Do not discharge too close to fire as the discharge stream may scatter the fire. As with any fire, keep away from the fuel source. Avoid breathing vapors, fumes and heated smoke as much as possible.

Water Fire Extinguishers

Water fire extinguishers contain a solution of water mixed with antifreeze. Water fire extinguishers are to be used on fabric or paper fires only. They are not to be used on electrical or grease fires.

Note: The directions for use of the fire extinguisher are printed on the extinguisher.

WARNING: An antifreeze compound has been added to the water which makes it unfit for drinking.

CAUTION: Do not use on electrical or grease type fires.

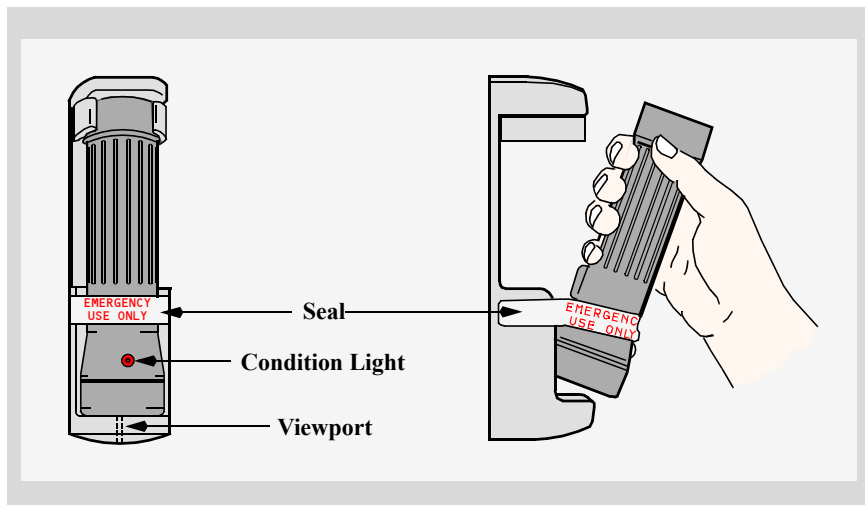
Portable Oxygen Bottles

Portable oxygen bottles are stowed in various locations in the cabin. The bottles are fitted with disposable masks and are used for first aid purposes or as walk-around units. All bottles are identical in size and capacity.

There are portable oxygen bottles stowed in various locations in the supernumerary area. The bottles are fitted with disposable mask and safety straps and are used for first aid purposes or as walk-around units. All bottles are identical in size and capacity.

Flashlights

Flashlights are stowed throughout the airplane. These high intensity flashlights illuminate automatically when they are removed from the stowage brackets. A battery indicator light flashes every three to four seconds to indicate adequate power. The light can be extinguished only by replacing the flashlight back into the stowage bracket. The batteries cannot be recharged. See Chapter 8, Emergency Equipment, for specific locations.

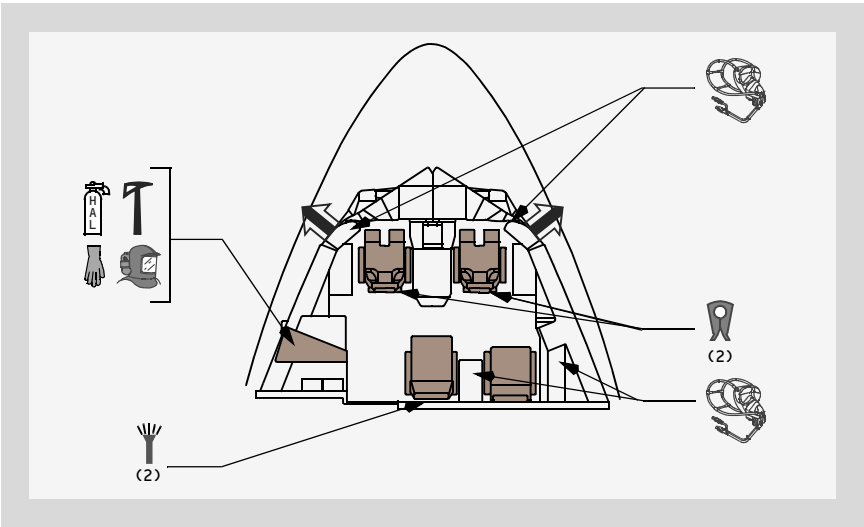


Emergency Equipment Symbols

 HALON EXTINGUISHER	 WATER EXTINGUISHER	 OXYGEN MASK WITH SMOKE GOGGLES	 PORTABLE OXYGEN BOTTLE	 PORTABLE BREATHING EQUIPMENT (PBE)
 EXIT PATH WITH ESCAPE SLIDE/RAFT	 EXIT PATH WITH ROPE	 EXIT PATH WITH SLIDE	 LIFE RAFT	 LIFE VEST
 FIRST AID KIT	 EMERGENCY MEDICAL KIT	 RESUSCITATOR	 SMOKE GOGGLES	
 PROTECTIVE GLOVES	 MEGAPHONE	 FLASHLIGHT	 EMERGENCY LOCATOR TRANSMITTER	 CRASH AXE

NOTE: Some symbols do not apply to all configurations.

Emergency Equipment Locations - Passenger Airplane Flight Deck



Passenger Cabin

[777-200 typical]

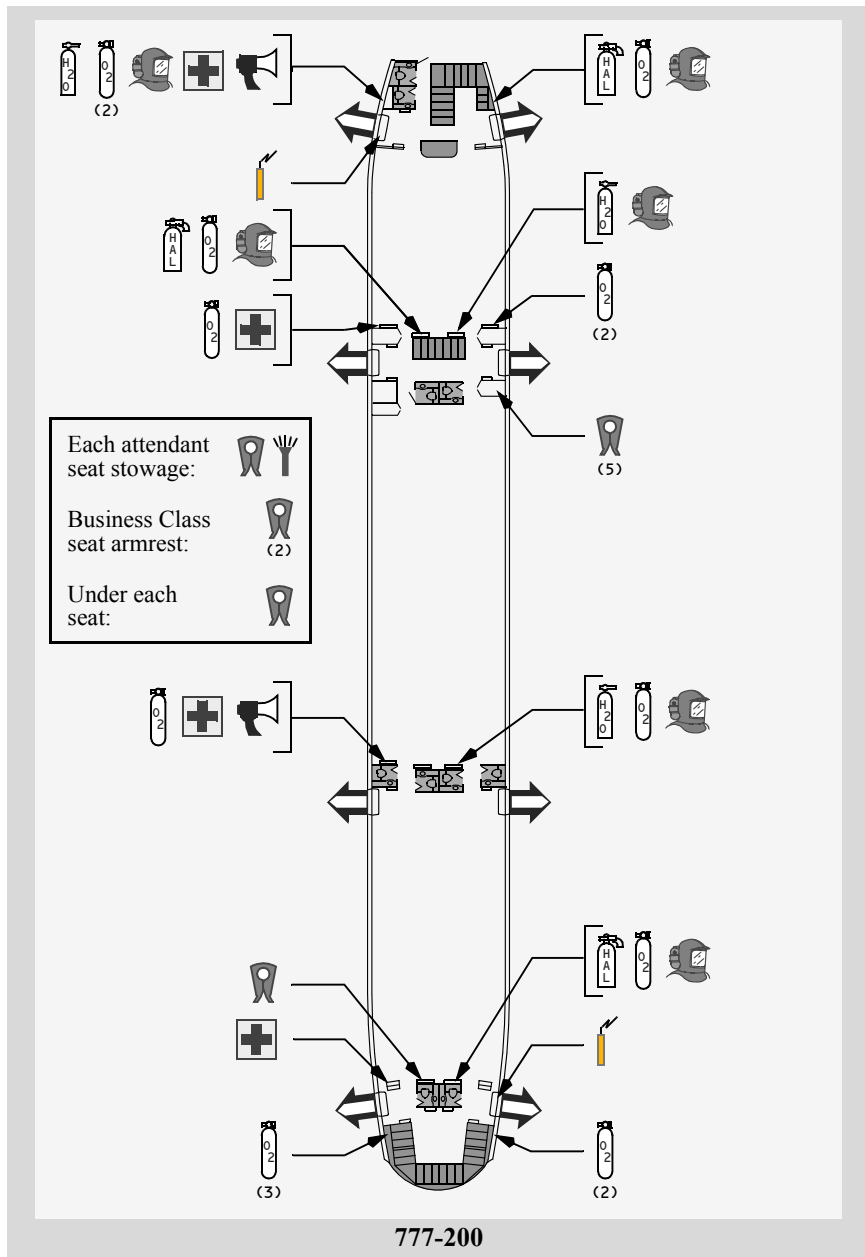
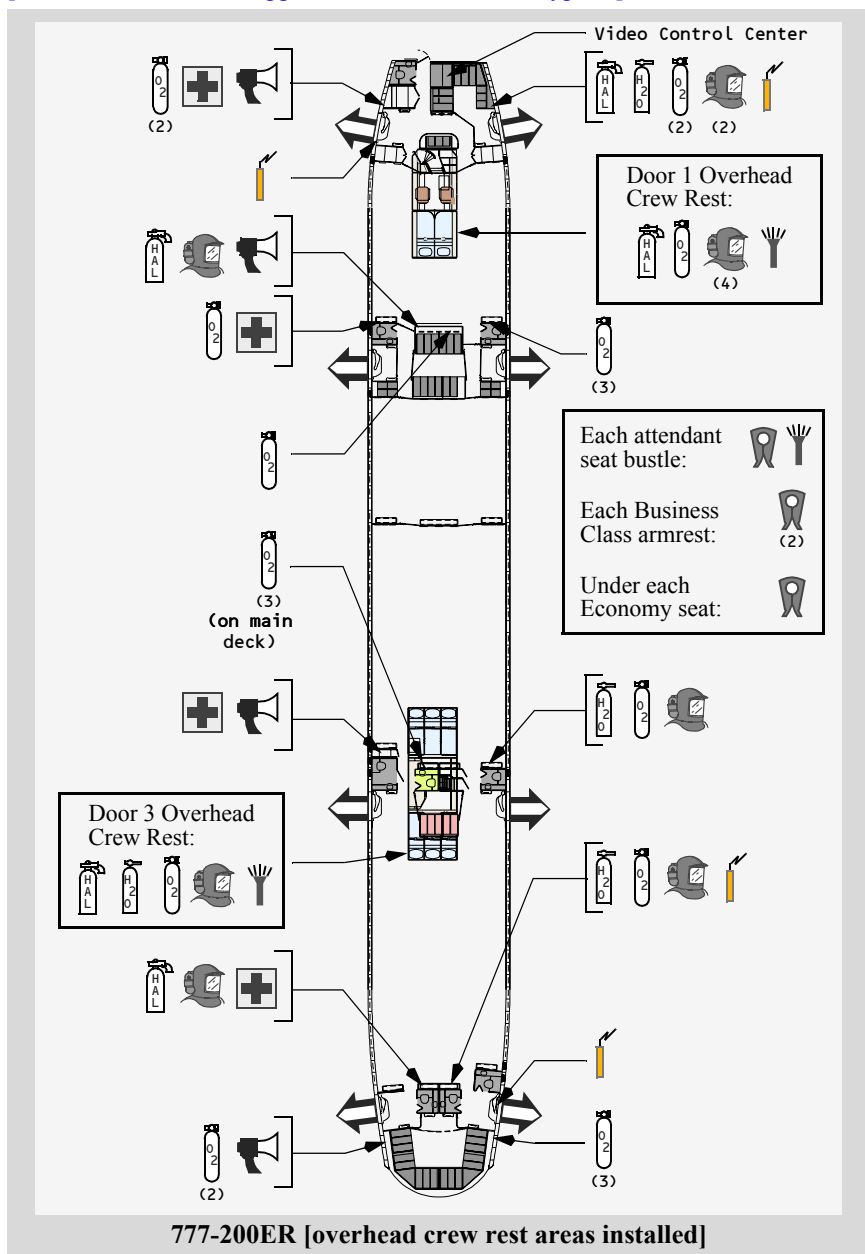


Diagram illustrating the location of various safety equipment on a 777-200ER aircraft, categorized by section:

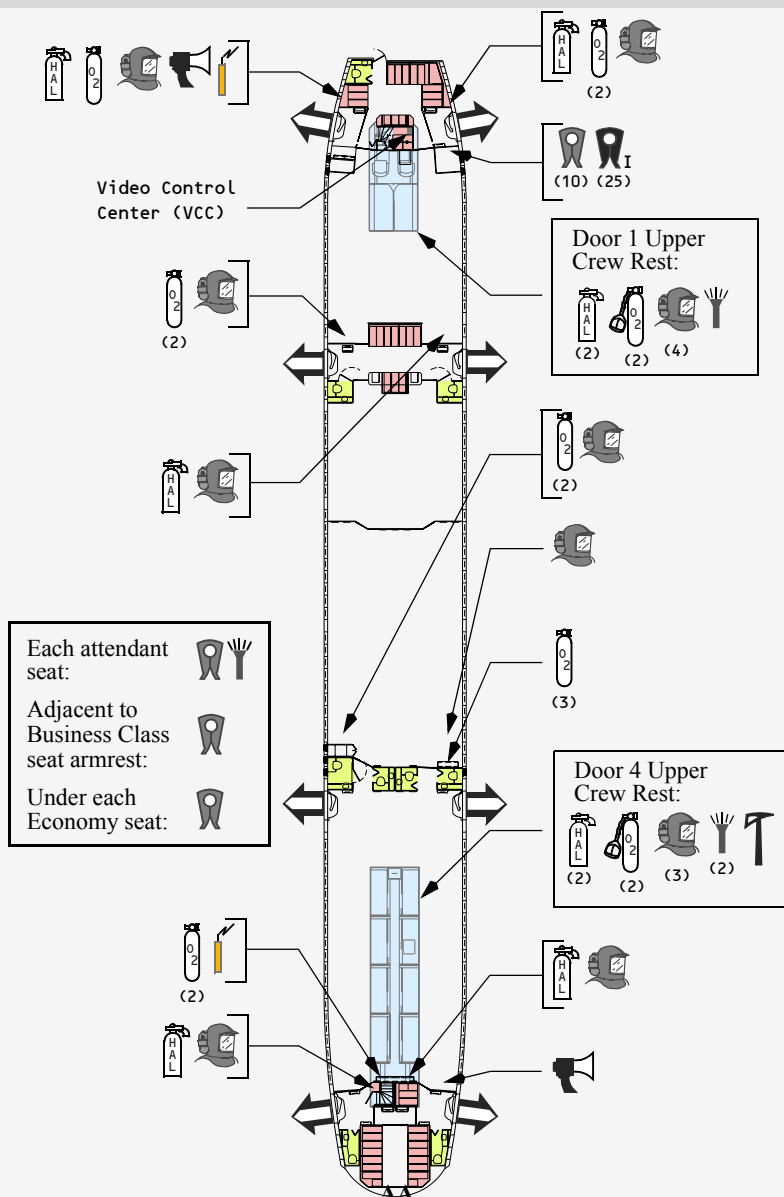
- Flight Crew Rest:** Located at the front of the aircraft.
- First Aid Kits (A):** Located in the forward and aft crew rest areas.
- Oxygen (O₂):** Located in the forward and aft crew rest areas.
- Fire Extinguishers (E):** Located in the forward and aft crew rest areas.
- Life Vests (L):** Located in the forward and aft crew rest areas.
- Each attendant seat storage:** Located in the forward and aft crew rest areas.
- In Business Class seat armrest:** Located in the forward and aft crew rest areas.
- Under each Economy seat:** Located in the forward and aft crew rest areas.
- In Lower Crew Rest:** Located in the lower crew rest area.

Quantities are indicated in parentheses: (2), (25), and (2).

[777-200ER Door 1/3 Upper Crew Rest installed, typical]

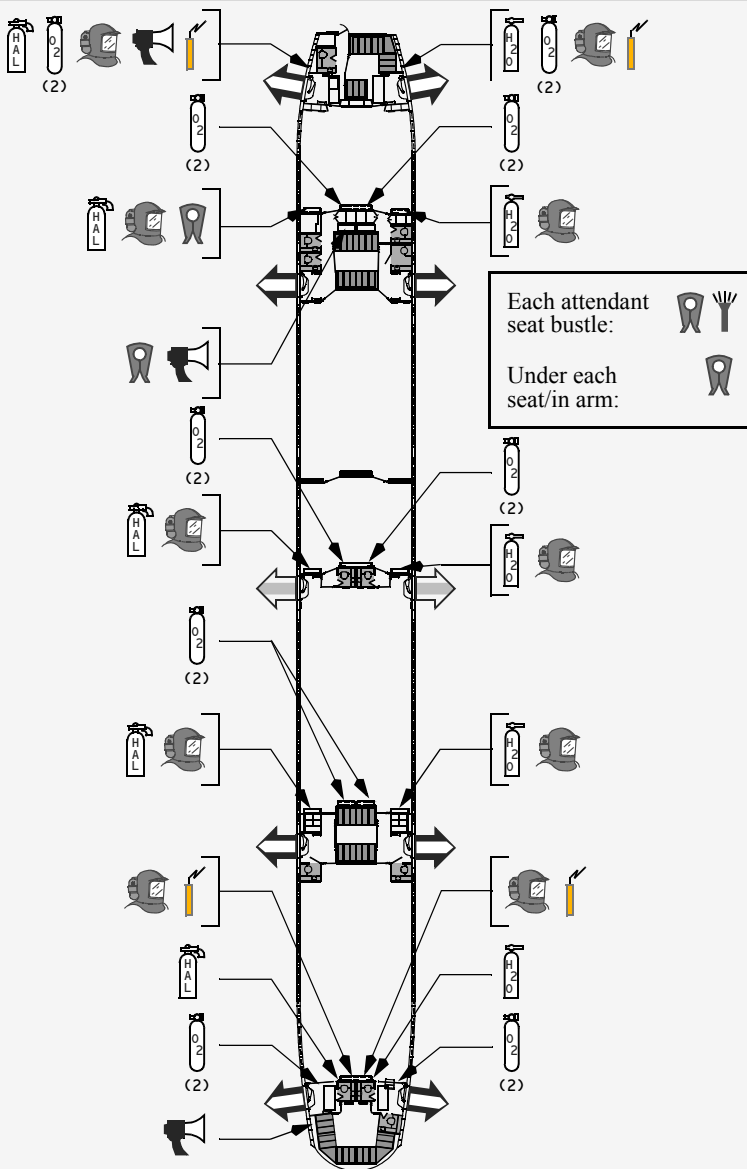


[777-200LR Door 1/3 Upper Crew Rest - installed, typical]

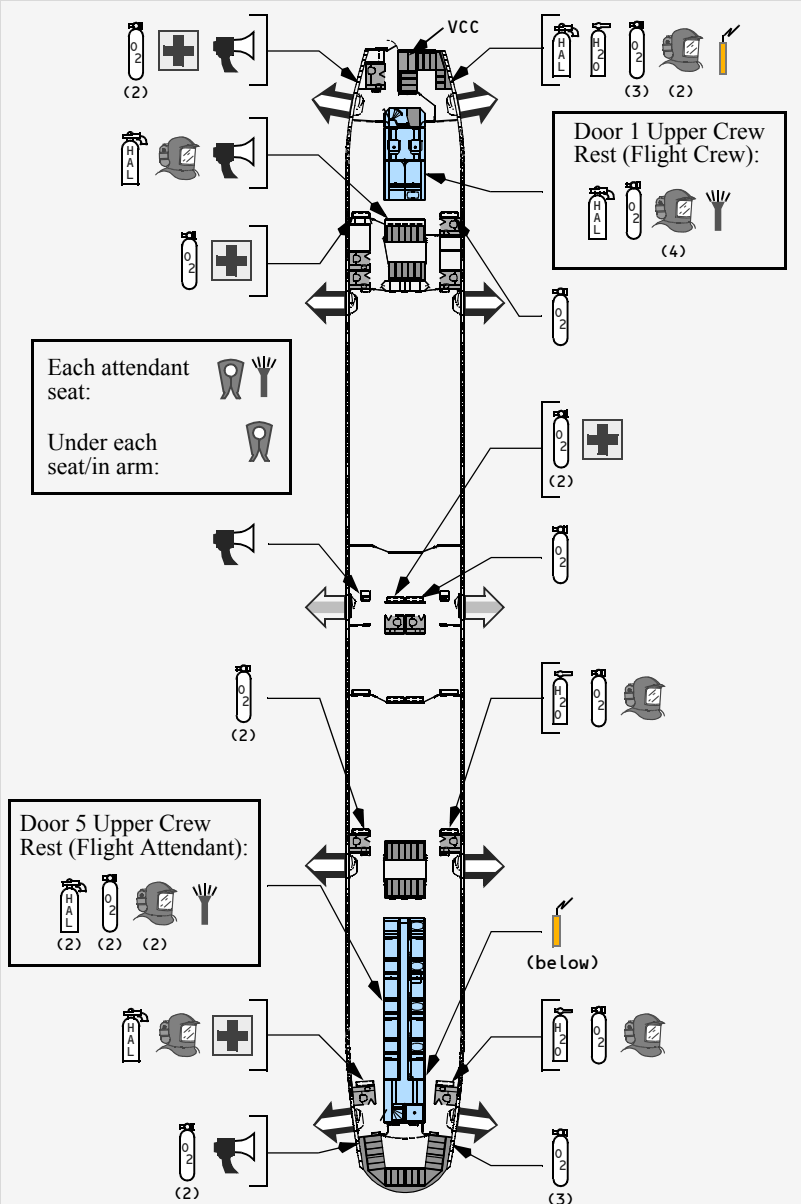


777-200LR

[777-300 typical]

**777-300**

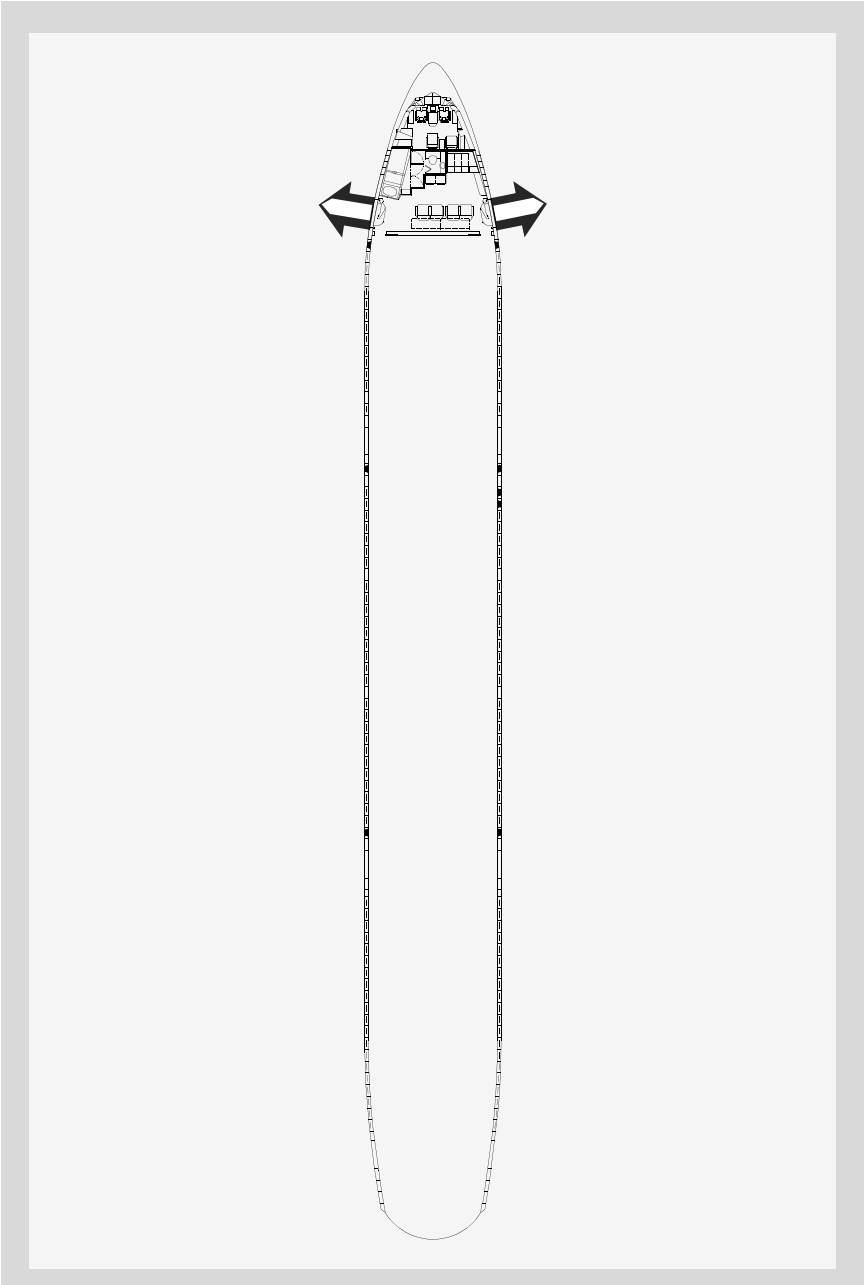
[777-300ER: Door 1/5 Upper Crew Rest - installed, typical]

**777-300ER**

[777-200F typical]

A detailed diagram of an aircraft cabin layout, viewed from above, showing the arrangement of seats and emergency equipment. The cabin is divided into several sections: a front section with four rows of seats, a middle section with two rows of seats, and a rear section with four rows of seats. The seats are color-coded: blue for the front section, yellow for the middle section, and red for the rear section. The diagram includes various emergency equipment locations, such as first aid kits, fire extinguishers, oxygen bottles, and life rafts. Arrows indicate the direction of evacuation. A box at the bottom of the diagram contains the text "At each supernumerary seat:" followed by a small icon of a person sitting in a seat.

Main Deck



**Airplane General, Emergency
Equipment, Doors, Windows
Flight Crew Rest****Chapter 1****Section 46**

This Section Applies to WY270

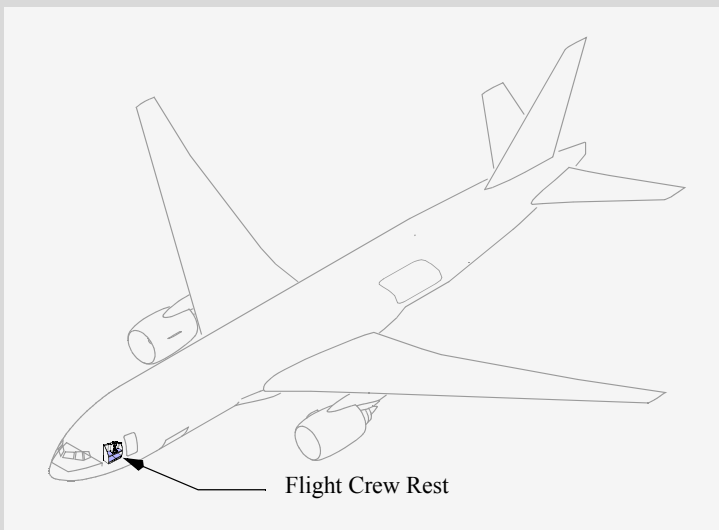
Introduction

This section describes the crew rest area, including:

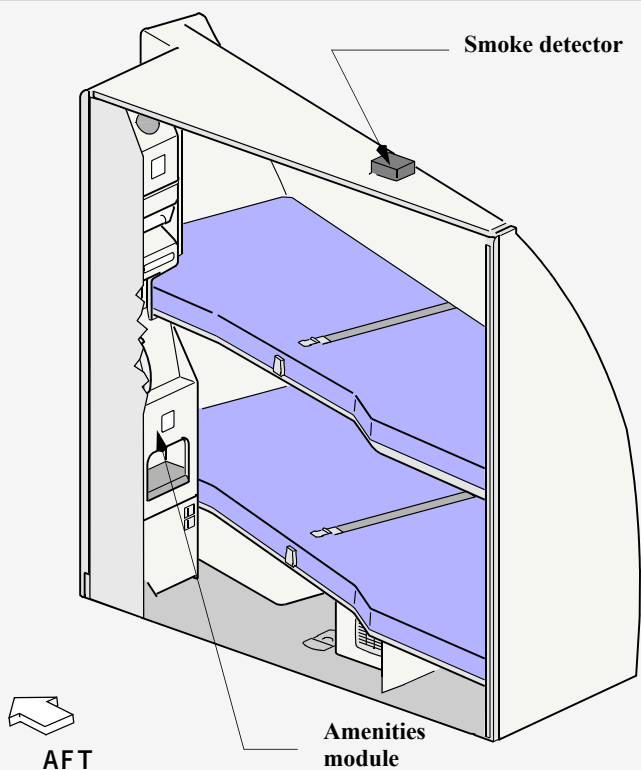
- location
- control panels
- layout
- smoke detection

Flight Crew Rest (FCR)

[Option: Flight Crew Rest Area installed]



A flight crew rest (FCR) area is located forward of the door 1L. The entrance to the FCR is located in the passageway between the supernumerary area and the flight deck.

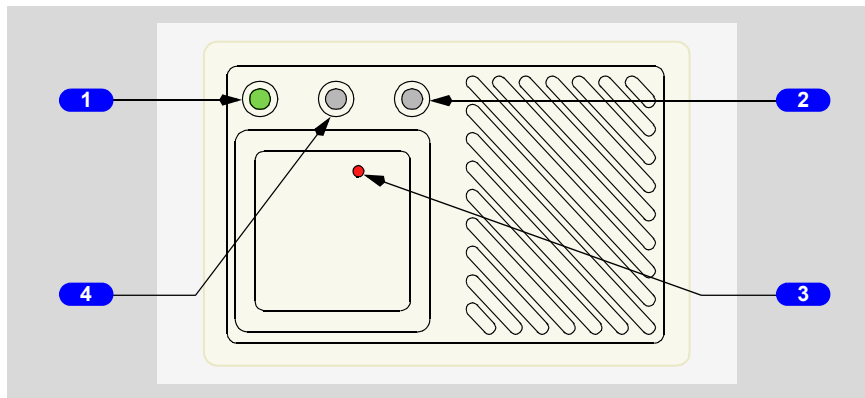


The FCR compartment contains the following:

- two bunks
- an amenities module containing:
 - a speaker
 - a smoke detector
 - lighting and temperature controls
 - decompression horn and silence switch
 - interphone handset

Crew Rest Smoke Detection

Crew Rest Smoke Detector



1 Power Indicator Light

Illuminated (green) -

- smoke detector has power and is operating

2 Self Test Switch

Push -

- activates the smoke detector aural and visual alarms

Note: The system automatically resets when the test is concluded.

3 Alarm Indicator Light

Illuminated (red) -

- presence of smoke has been detected

4 Interrupt Switch

Push -

- silences the horn and suppresses all alarm indications as long as the switch is pushed

Crew Rest Smoke Detection System

Smoke detectors with an integral alarm horn are installed in the crew rest enclosure:

- three smoke detectors are installed in the crew rest area:
 - one on the crew rest ceiling
 - one smoke detector is installed in each bunk area

If smoke is detected in the FCR:

- on the flight deck:
 - the master caution light illuminates
 - an aural caution alarm sounds
 - a SMOKE CREW REST F/D Engine Indication and Crew Alerting System (EICAS) caution message is displayed
- in the crew rest area:
 - the respective smoke detector alarm indicator light illuminates
 - the pulsing smoke detection system alarm horns sound
 - all area lights illuminate
 - the crew rest area air supply valves are closed and the area smoke evacuation valves are opened
- in the supernumerary area:
 - the amber Smoke Detection Light/Reset Switch above the entrance enclosure door flashes
 - continuous HI/LO chime sounds
 - a SMOKE DETECTED FCR message appears on the cabin management system control panels

Intentionally
Blank



1 Area Light

2 Handle Light

3 Reading Light Switch

Turns upper bunk reading light on or off.

4 FASTEN SEAT BELTS Sign

5 Reading Light Switch

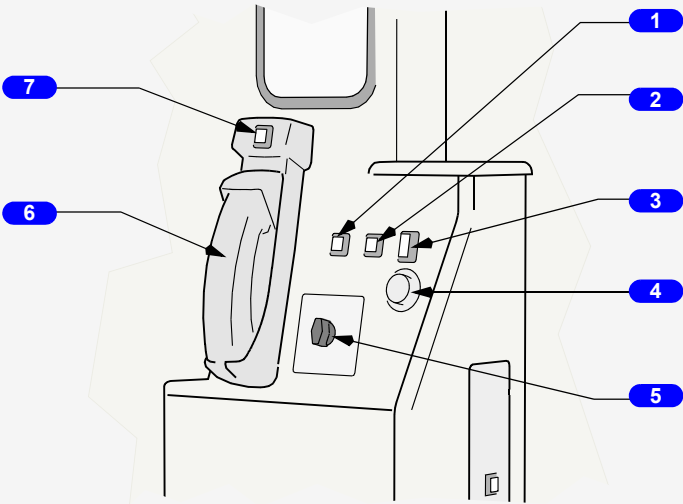
Turns lower bunk reading light on or off.

6 Step Light

7 Back Up Light

Note: Illuminates when normal airplane power fails.

8 Speaker



Amenities Module Control Panel

1 Area Light Switch

2 Horn Shutoff Switch

Push -

- silences the decompression alarm horn

3 Lavatory Occupied Indicator

4 Alert horn

Horn sounds when:

- airplane decompression occurs (continuous)

5 Crew Rest Heater

OFF -

- turns off crew rest area heater

HIGH -

- turns crew rest area heater to high heat

6 Interphone Handset

7 Interphone Call Switch/Light

Illuminated

- incoming call from flight deck

Push -

- calls the flight deck

Intentionally
Blank

**Airplane General, Emergency
Equipment, Doors, Windows
Overhead Crew Rest****Chapter 1****Section 47**

This Section Applies to WY250, WY260, WY350

Introduction

This section describes the overhead crew rest areas, including:

- location and entry enclosure
- control panels
- layout
- smoke detection
- emergency equipment and location
- evacuation using the emergency hatch

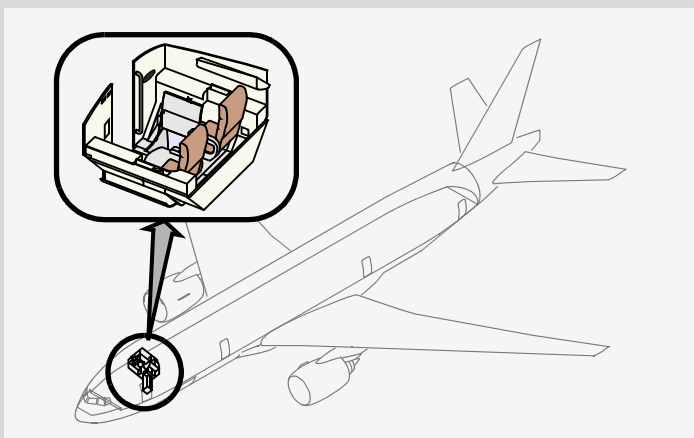
Door 1 Upper Crew Rest

[Option: Crew Rest installed]

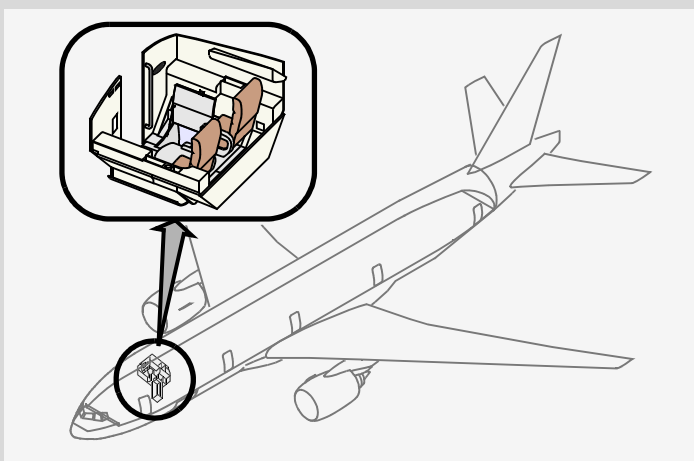
A door 1 upper crew rest area is located in the forward part of the airplane near door 1. Access into the area is through an enclosure located in the passenger cabin near door 1L.

The area has its own smoke detection system but no fire extinguishing system.

WY250, WY260



WY350



Occupancy

(Option shown: Crew rest certified for occupancy during taxi, take-off, and landing)

Door 1 Upper Crew Rest Occupancy

The door 1 upper crew rest is to be occupied by crew members trained in the use of the crew rest evacuation routes, fire fighting procedures and depressurization procedures.

Note: A placard is installed indicating any door 1 upper crew rest area occupancy restrictions.

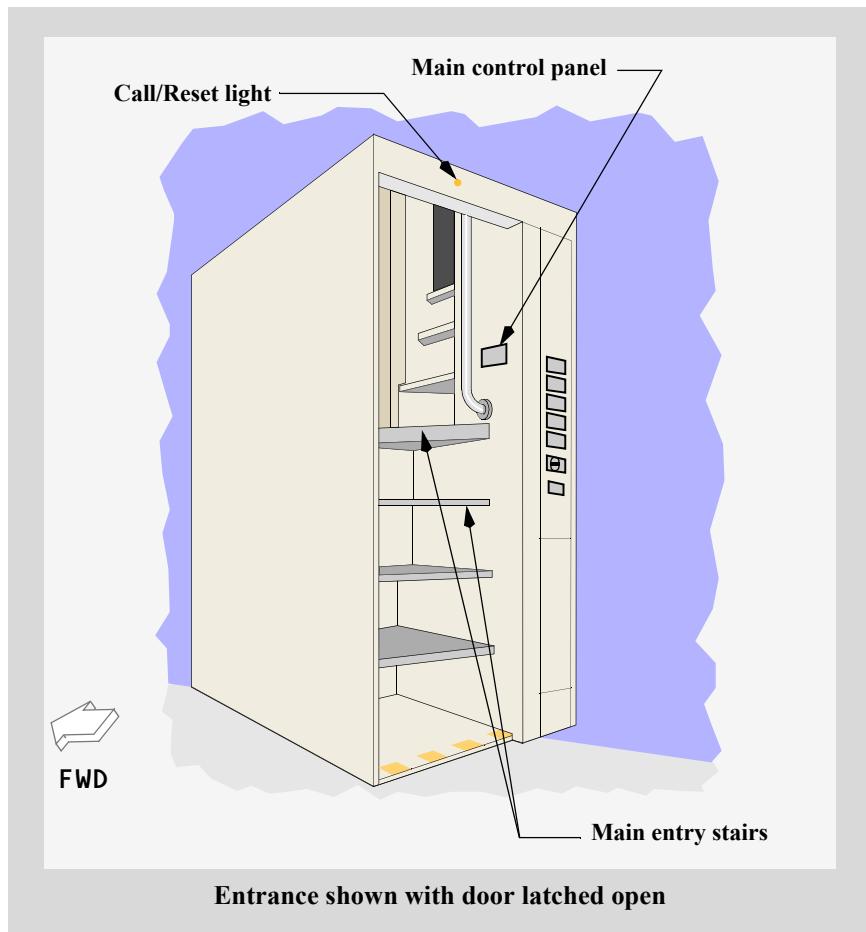
Note: The crew rest area is not to be occupied during taxi, takeoff, or landing operations.

WARNING: The upper crew rest area should not be occupied when the amber SUPPLY AIRFLOW OFF light is illuminated.

Entrance Enclosure

Entry into the door 1 upper crew rest area is through an enclosure located in the passenger cabin near door 1L. The entrance to the crew rest area has the same external appearance as a lavatory, but is placarded for crew use.

The entrance enclosure contains a area main control panel.



An amber call/reset light/switch is mounted on the exterior wall above the entrance door. When smoke is detected in the area, the light flashes. The light will illuminate steady when the attendant call button on a passenger control unit (PCU) inside the area has been pushed.

Conditioned air is used to provide temperature control and ventilation to the door 1 upper crew rest area. When using the area, conditioned air flow must be available. An amber SUPPLY AIRFLOW OFF light on the main control panel in the entrance enclosure illuminates when conditioned air is not available.

Before entering the crew rest area, ensure that conditioned air flow is available. Verify that the SUPPLY AIRFLOW OFF light on the control panel in the entrance enclosure is not illuminated.

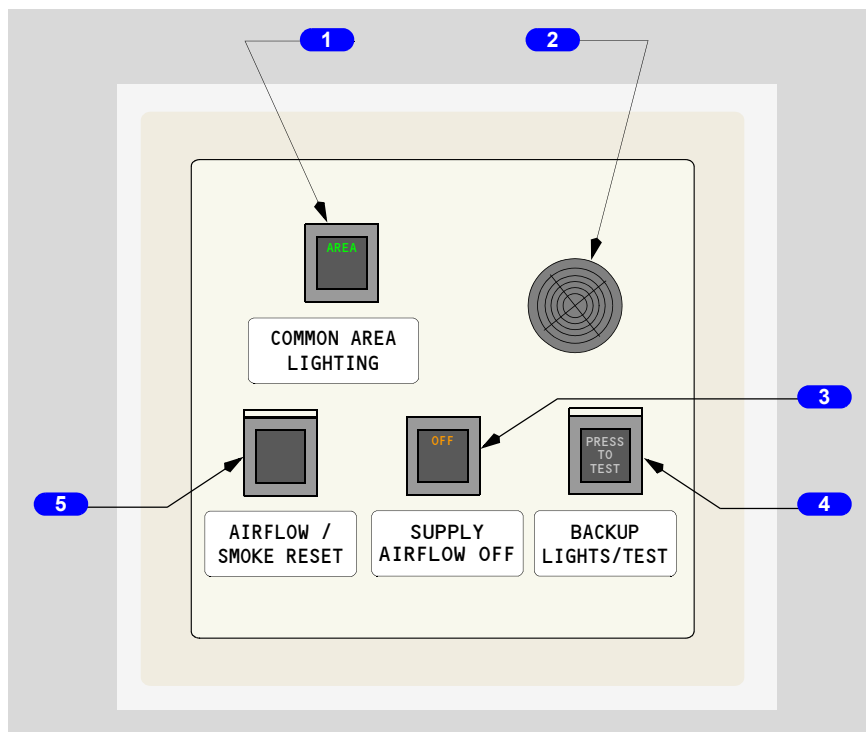
Note: The SUPPLY AIRFLOW OFF light will be illuminated when the airplane is below 25,000 feet.

Note: If the airplane is above 25,000 feet and the SUPPLY AIRFLOW OFF light is illuminated, pushing the AIRFLOW / SMOKE RESET switch resets the conditioned air system.

WARNING: If the SUPPLY AIRFLOW OFF light remains illuminated after the AIRFLOW / SMOKE RESET switch has been pushed, the door 1 upper crew rest area should not be occupied.

Main Control Panel

The door 1 upper crew rest area main control panel is located inside the entrance enclosure.



1 COMMON AREA LIGHTING Switch

Push -

- turns the common seating area lights in the area on (light illuminated)/off (light extinguished).

2 Alert horn

Horn sounds when:

- airplane decompression occurs (continuous)
- smoke is detected in the overhead crew rest area (pulsating)

3 SUPPLY AIRFLOW OFF Light

Illuminated (amber) -

- area airflow exhaust valves are open or during smoke detection mode operations
- the area airflow is off

Note: A HI/LO chime will sound 5 times in the area whenever the air supply shutoff valve is commanded closed.

Note: The SUPPLY AIRFLOW OFF light will be illuminated when the airplane is below 25,000 feet or in the smoke detection mode.

WARNING: The upper crew rest area should not be occupied when the amber SUPPLY AIRFLOW OFF light is illuminated.

4 BACKUP LIGHTS/TEST Switch

Guarded switch/light.

Push - illuminated (white) -

- turns the emergency lights in the area on (light illuminated)/off (light extinguished)

Push and hold (2 seconds) -

- the emergency lights in the area turn on for approximately one minute

5 AIRFLOW / SMOKE RESET Switch

Guarded switch.

Push and hold (2 seconds) -

- resets the airflow to the area

WY350

- resets aft galley electrical power

Note: In airplanes with a door 1 upper crew rest and a door 5 upper crew rest, both AIRFLOW / SMOKE RESET switches must be pushed to ensure proper restoration of the aft galley power.

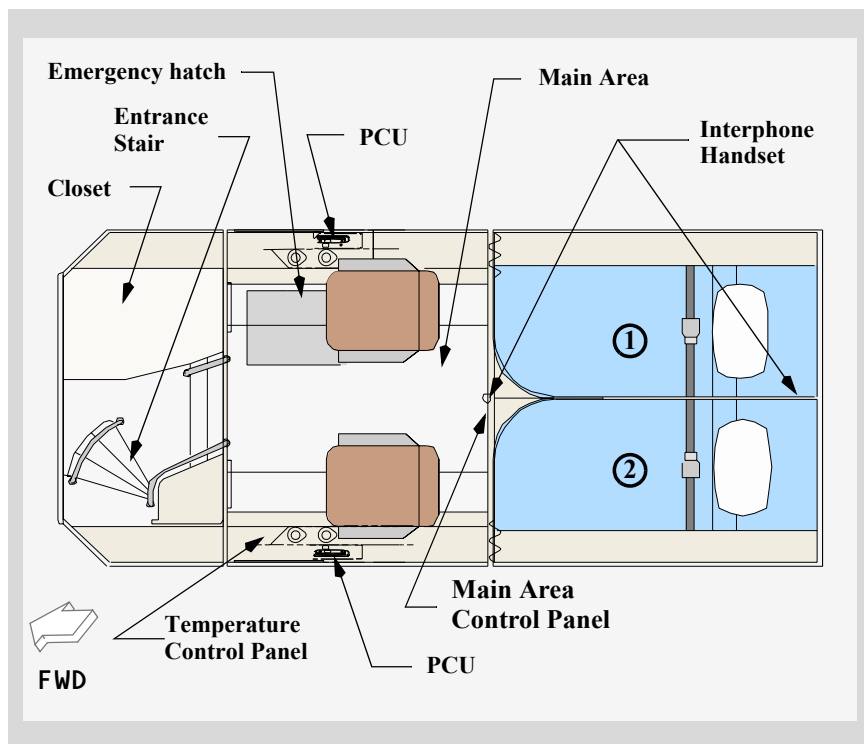
WY250, WY260

Note: The AIRFLOW / SMOKE RESET switch is inoperative when the airplane is below 25,000 feet.

WY350

Note: The AIRFLOW / SMOKE RESET switch is operative only when the airplane is on the ground or above 25,000 feet.

Crew Rest Layout

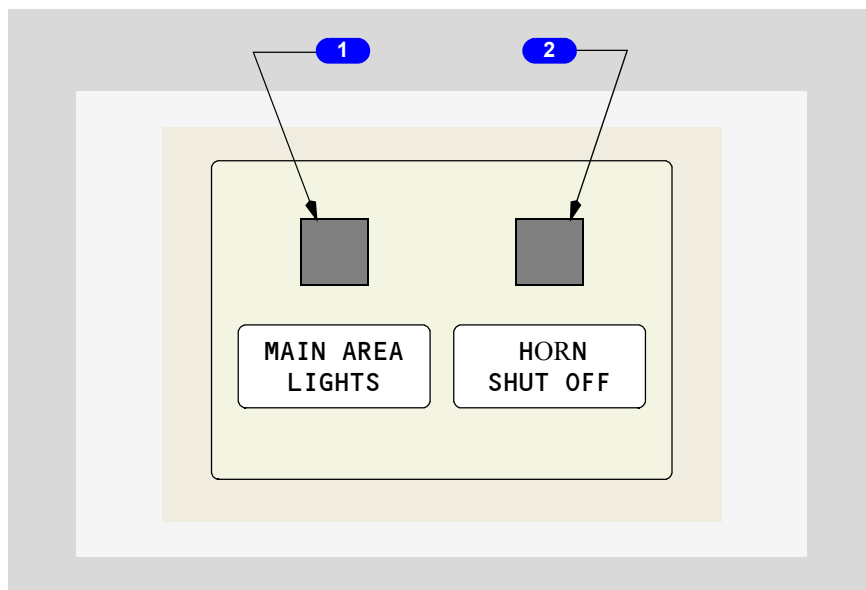


The door 1 upper crew rest area contains the following:

- a main seating area containing:
 - control/warning panels
 - lighting and temperature control panels
 - 2 seats
- bunks (circled numbers 1 through 2)
- interphone handsets (2)
- emergency hatch
- passenger control units (PCUs)
- smoke detectors
- emergency equipment

Main Area Control Panels

Area Lights/Decompression Reset Panel



1 MAIN AREA LIGHTS Light/Switch

Push -

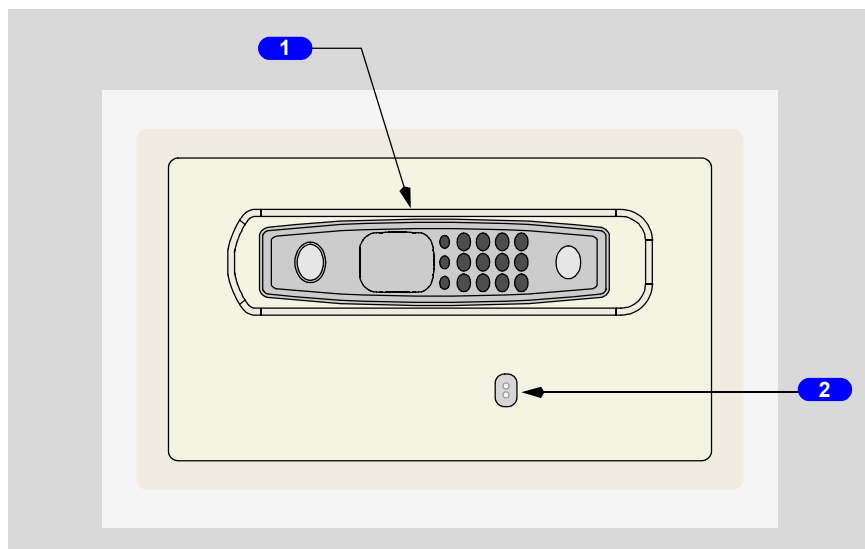
- turns area lights on/off.

2 HORN SHUT OFF Switch

Push -

- silences the smoke detector system alarm horns
- silences the decompression alarm horns

IFE PCU Panel

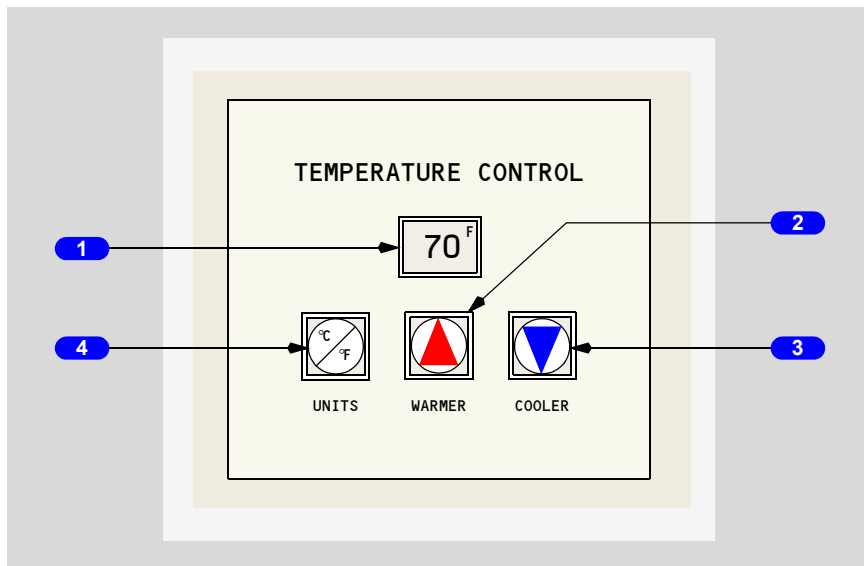


1 Passenger Control Unit (PCU)

2 Audio Connection

Temperature Control System

Temperature Control Panel



1 Temperature Display

Displays -

- current ambient air temperature in degrees F or C

Flashing -

- new temperature set point when warmer or cooler arrows are pushed

2 WARMER Arrow

Push -

- increases temperature in crew rest area when the temperature display is flashing

Note: Push and hold the WARMER arrow until the temperature display flashes. This allows the target temperature to be changed using the arrow.

3 COOLER Arrow

Push -

- decreases temperature in crew rest area when the temperature display is flashing

Note: Push and hold the COOLER arrow until the temperature display flashes. This allows the target temperature to be changed using the arrow.

4 UNITS Selector

Push -

- toggles between degrees F and degrees C for display and temperature selection

Temperature Control System Operation

The temperature in the crew rest area is controlled by the temperature controller located in the common area. The temperature may be set between 65 degrees F (18 degrees C) and 85 degrees F (29 degrees C).

Note: If the SUPPLY AIRFLOW light is illuminated on the main control panel, temperature can not be controlled inside the crew rest and the door to the enclosure may be opened to provide air from the cabin.

Increase Temperature

To increase the temperature:

- observe the actual temperature
- push and hold the WARMER arrow until the temperature display begins to flash
- continue holding the WARMER arrow until the target temperature is reached

Note: Do not expect an immediate change in the temperature.

Note: Maximum controllable temperature is 85 degrees F (29 degrees C).

Decrease Temperature

To decrease the temperature:

- observe the actual temperature
- push and hold the units selector until the temperature display begins to flash
- continue holding the COOLER arrow until the target temperature is reached

Note: Do not expect an immediate change in the temperature.

Note: Minimum controllable temperature is 65 degrees F (18 degrees C).

Oxygen System

[Option shown: Chemical oxygen - 12 minutes]

[Option: Chemical oxygen - 22 minutes; Gaseous oxygen system]

The crew rest oxygen system is a chemical oxygen generator system which provides oxygen for approximately 12 minutes.

The oxygen masks above the bunks and seats will drop automatically in the event of a decompression.

Each mask oxygen valve is held closed by a pin inserted into the valve. Pulling on the mask withdraws the pin, causing the mask oxygen valve to open and oxygen to flow to that mask.

The oxygen masks may be manually released by inserting a hair pin or thin rod into the hole of the oxygen compartment cover.

Note: Cabin depressurization is indicated by a continuous alarm horn sounding in the crew rest area.

Decompression

If a cabin decompression occurs during cruise:

- a decompression (continuous) horn sounds in the crew rest area

The oxygen masks located above the bunks and seats will automatically deploy when the cabin altitude is above 13,500 feet. Oxygen flow is available when the mask or yellow streamer attached to the mask is pulled.

Crew rest occupants should immediately don one of the PSU or bunk service unit oxygen masks, move to an unoccupied position, and fasten the seat/bunk lap belt.

WARNING: It is acceptable to reach over a seat/bunk occupant to obtain an open/unused oxygen mask to prevent oxygen deprivation / light-headedness when moving to an unoccupied position.

Evacuate the upper crew rest area when directed by the flight crew.

Note: Prior to evacuating the upper crew rest area, push the HORN SHUT OFF switch (located in the crew rest common area). This will silence the decompression alarm horns in the overhead crew rest area.

Crew Rest Smoke Detection System Operation

Smoke detectors with an integral alarm horn are installed in the crew rest enclosure and the crew rest module:

- one smoke detector is installed inside the entrance enclosure

WY260, WY350

- one smoke detector is installed in the mid-level closet area
- two smoke detectors are installed in the crew rest area seating area
 - one on the forward left-hand wall
 - one on the ceiling between the seats
- one smoke detector is installed in each bunk area

Note: Smoke detection is annunciated by a pulsing alarm horn sounding in the crew rest area and the entrance enclosure.

If smoke is detected in the door 1 upper crew rest area:

- on the flight deck:
 - the master caution light illuminates
 - an aural caution alarm sounds
 - a SMOKE REST UPR DR 1 Engine Indication and Crew Alerting System (EICAS) caution message is displayed
- in the crew rest area:
 - the respective smoke detector alarm indicator light illuminates
 - the pulsing smoke detection system alarm horns sound
 - all area lights illuminate
 - the crew rest area air supply valves are closed and the area smoke evacuation valves are opened
- at the entrance main control panel:
 - SUPPLY AIRFLOW OFF light illuminates
 - an alarm horn sounds
- in the passenger cabin:
 - the amber light above the entrance enclosure door flashes
 - a SMOKE DETECTED DR1 UPR REST message appears on the cabin management system control panels

WY350

- aft galley electrical power is removed
- the cabin master call lights flash

Continue to monitor the area until the smoke detector red alarm indicator light extinguishes.

Once the smoke clears, the red alarm indicator light extinguishes, the smoke detector is sensitive to smoke again.

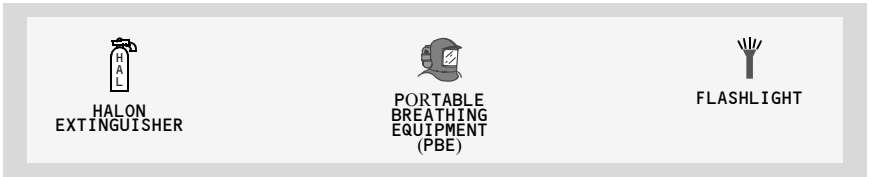
Note: When the smoke detector has been activated, lingering smoke in the detector sensor may cause reactivation. Blowing air into the detector sensor (the small screen cutout on the side of the cube extending from the unit) may clear lingering smoke.

Emergency Equipment

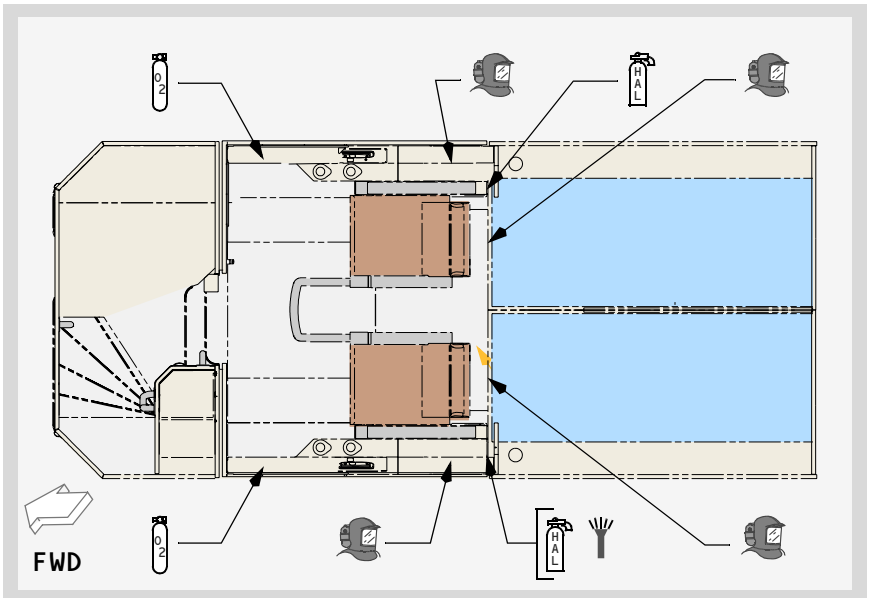
Door 1 upper crew rest emergency equipment includes:

- halon fire extinguishers (2)
- portable oxygen bottles (2)
- protective breathing equipment (PBE) (4)
- flashlight (1)
- life vests (2)

Emergency Equipment Symbols



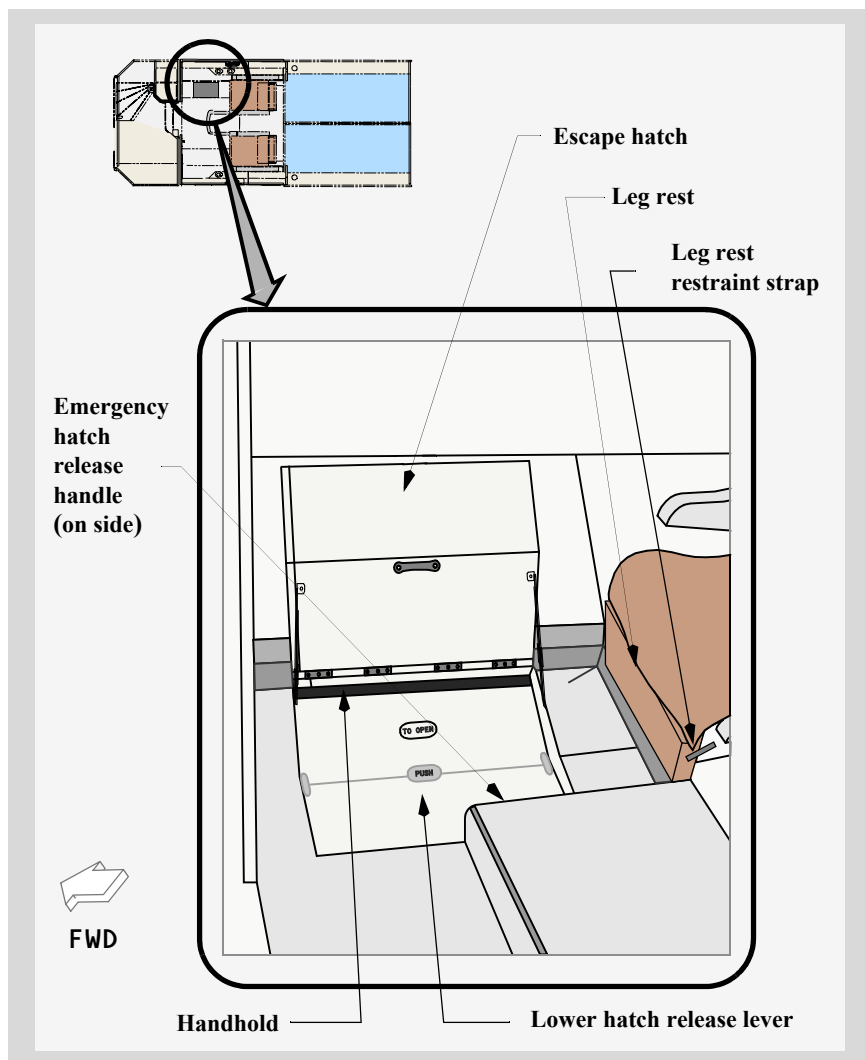
Emergency Equipment Location



Evacuation using the Emergency Hatch

The primary evacuation route is down the entrance stairway through entrance enclosure.

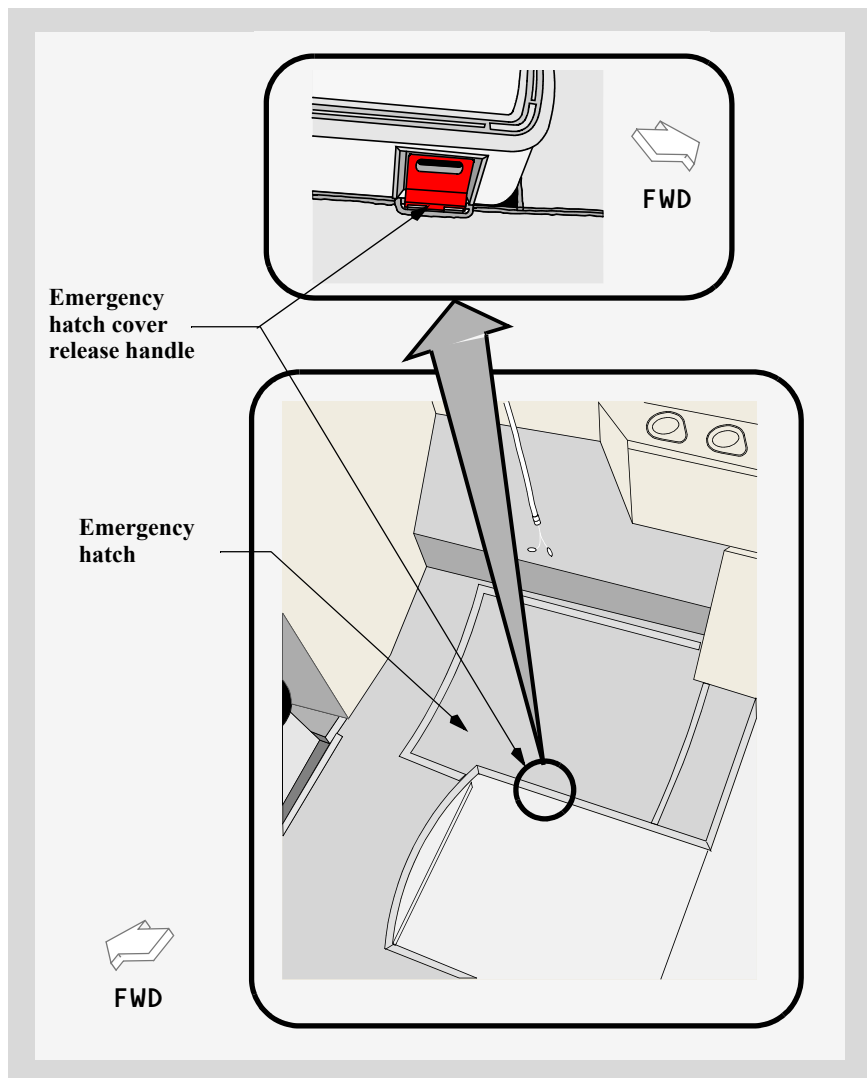
If the main entrance is unusable, evacuation is possible through the emergency hatch located on the right side of the area.



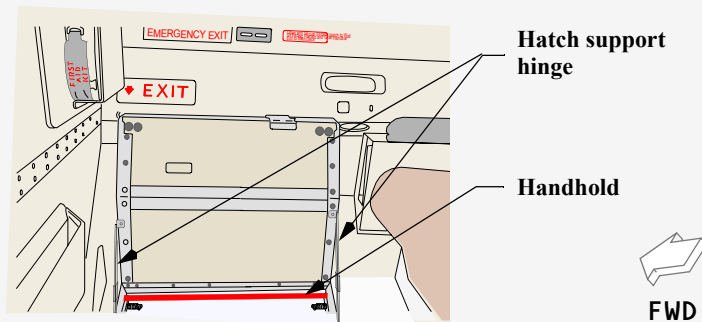
For egress:

- retract right seat leg rest (if required)

Note: Secure the seat leg rest using the seat leg rest restraint straps.



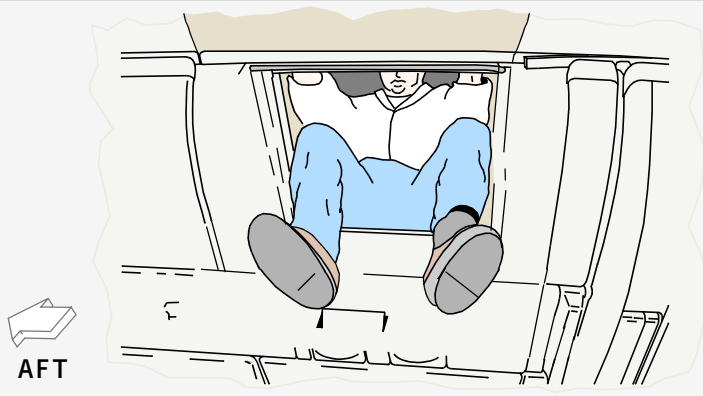
- unlatch upper hatch using the emergency hatch cover release handle



- raise upper hatch cover to fully open position to lock the hatch support hinge in place

WARNING: Failure to ensure the hatch cover is locked in position may allow the hatch to unexpectedly close causing injury.

- unlatch lower hatch
 - push the lower hatch release lever
- command passengers in immediate area to move clear of evacuation area



- sit on floor facing outboard and lower legs into hatch opening
- reach out and grab the outboard handhold
 - keep elbows close to sides



- swing down to main deck

WARNING: During exit to the main deck, stepping on the seat back may cause the seat back to fold forward. If this occurs, the crew member may lose balance and hand grip, resulting in personal injury.

- close the lower hatch when evacuation is complete

WARNING: If the emergency hatch was used for crew evacuation, the lower hatch must be closed to help prevent the spread of smoke or fire.

This Section Applies to WY250, WY260

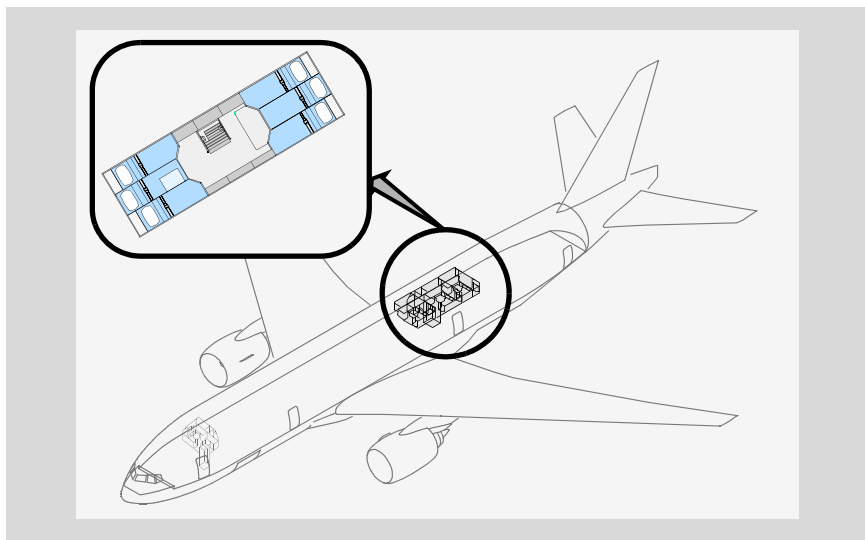
Door 3 Upper Crew Rest

[Option shown: 6 bunks; option 7 bunks, 8 bunks]

Note: The crew rest area should not be occupied during taxi, takeoff, or landing operations.

A door 3 upper crew rest area is located in the aft part of the airplane in the overhead above door 3. Entry into the area is through an enclosure located in the passenger cabin near door 3R.

The area has its own smoke detection system but no fire extinguishing system.



Occupancy

The door 3 upper crew rest is to be occupied by crew members trained in the use of the crew rest evacuation routes, fire fighting procedures and depressurization procedures.

Note: A placard is installed indicating any door 3 upper crew rest area occupancy restrictions.

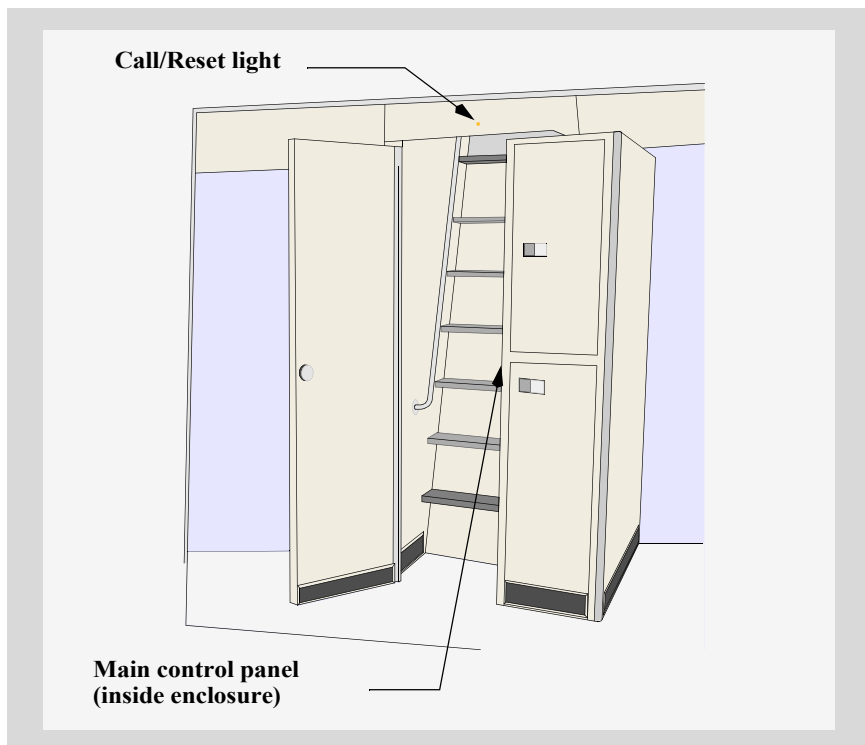
WARNING: The upper crew rest area should not be occupied when the amber AIRFLOW OFF light is illuminated.

Entrance Enclosure

Entry into the crew rest area is through an enclosure located in the passenger cabin across from door 3R. The entrance to the crew rest area has the same external appearance as a lavatory, but is placarded for crew use only.

The door should remain closed and locked at all times.

The entrance enclosure contains a area main control panel.



An amber call/reset light/switch is mounted on the exterior wall above the entrance door. When smoke is detected in the area, the light flashes. The light will illuminate steady when the attendant call button on a passenger control unit (PCU) inside the area has been pushed.

Conditioned air is used to provide temperature control and ventilation to the door 3 upper crew rest area. When using the area, conditioned air flow must be available. An amber AIRFLOW OFF light on the main control panel in the entrance enclosure illuminates when conditioned air is not available.

Note: The AIRFLOW OFF light will be illuminated when the airplane is below 25,000 feet.

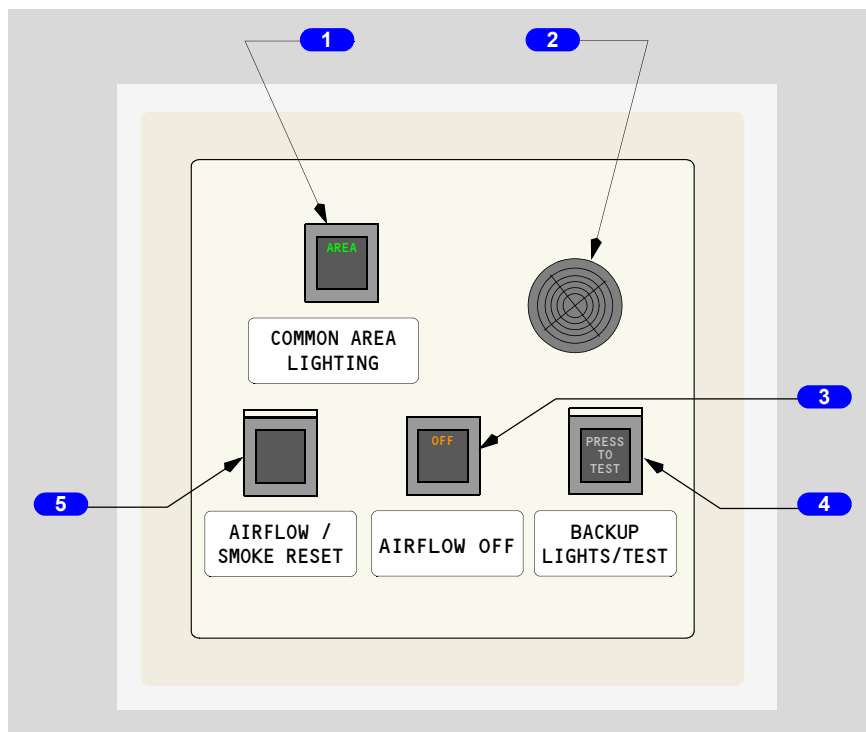
Note: If the airplane is above 25,000 feet and the AIRFLOW OFF light is illuminated, pushing the AIRFLOW / SMOKE RESET switch resets the conditioned air system.

WARNING: If the AIRFLOW OFF light remains illuminated after the AIRFLOW / SMOKE RESET switch has been pushed, the door 3 upper crew rest area should not be occupied.

Entrance Enclosure Control Panel

The door 3 upper crew rest area master panels are located inside the entrance enclosure.

Main Control Panel



1 COMMON AREA LIGHTING Switch/Light

Push -

- turns the common seating area lights in the area on (light illuminated)/off (light extinguished)

2 Alert horn

Horn sounds when:

- airplane decompression occurs (continuous)
- smoke is detected in the overhead crew rest area (pulsating)

3 AIRFLOW OFF Light

Illuminated (amber) -

- area airflow exhaust valves are open or during smoke detection mode operations
- the area airflow is off

Note: A HI/LO chime will sound 5 times in the area whenever the air supply shutoff valve is commanded closed.

Note: The AIRFLOW OFF light will be illuminated when the airplane is below 25,000 feet or during smoke detection mode.

WARNING: The upper crew rest area should not be occupied when the amber AIRFLOW OFF light is illuminated.

4 BACKUP LIGHTS/TEST Switch/Light

Guarded switch/light.

Push - illuminated (white) -

- turns the emergency lights in the area on (light illuminated)/off (light extinguished)

Push and hold (2 seconds)

- the emergency lights in the area turn on for approximately one minute

5 AIRFLOW / SMOKE RESET Switch

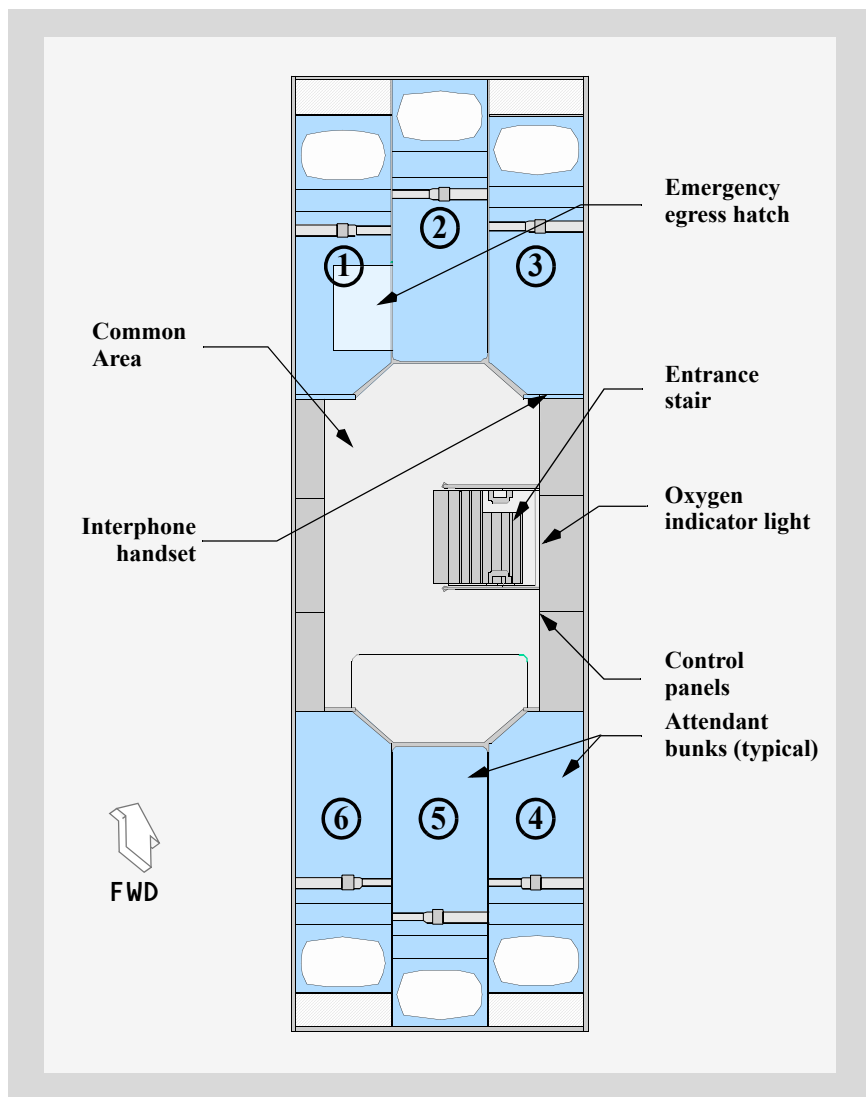
Guarded switch.

Push and hold (2 seconds) -

- resets the airflow to the area

Note: The AIRFLOW / SMOKE RESET switch is inoperative when the airplane is below 25,000 feet.

Crew Rest Layout

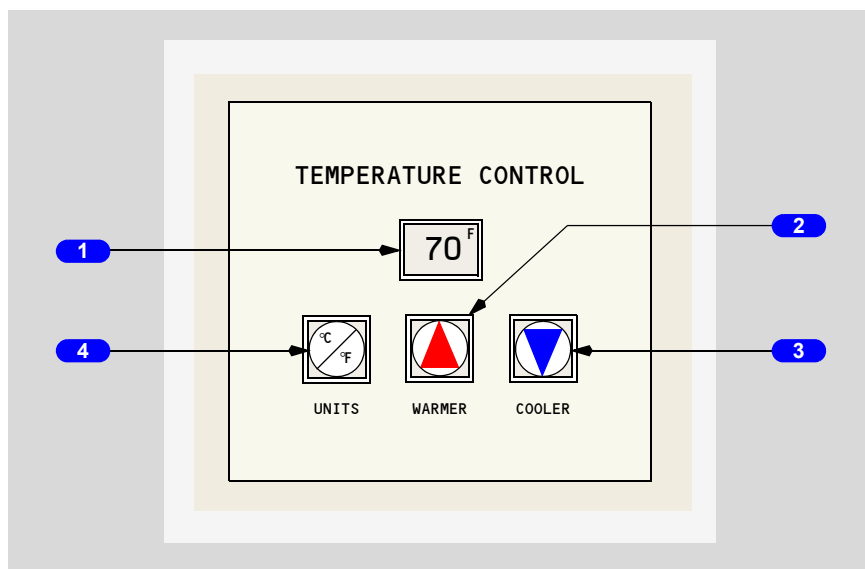


The door 3 upper crew rest area contains the following:

- a common area containing:
 - control/warning panels
 - lighting and temperature control panels
 - interphone handset
- emergency hatch
- passenger control units (PCUs)
- emergency hatch
- smoke detectors
- emergency equipment

Temperature Control System

Temperature Control Panel



1 Temperature Display

Displays -

- current ambient air temperature in degrees F or C

Flashing -

- new temperature set point when warmer or cooler arrows are pushed

2 WARMER Arrow

Push -

- increases temperature in crew rest area when the temperature display is flashing

Note: Push and hold the WARMER arrow until the temperature display flashes. This allows the target temperature to be changed using the arrow.

3 COOLER Arrow

Push -

- decreases temperature in crew rest area when the temperature display is flashing

Note: Push and hold the COOLER arrow until the temperature display flashes. This allows the target temperature to be changed using the arrow.

4 UNITS Selector

Push -

- toggles between degrees F and degrees C for display and temperature selection

Temperature Control System Operation

The temperature in the crew rest area is controlled by the temperature controller located in the common area. The temperature may be set between 65 degrees F (18 degrees C) and 85 degrees F (29 degrees C).

Note: The temperature control system is inoperative below 25,000 feet.

Increase Temperature

To increase the temperature:

- observe the actual temperature
- push and hold the WARMER arrow until the temperature display begins to flash
- continue holding the WARMER arrow until the target temperature is reached

Note: Do not expect an immediate change in the temperature.

Note: Maximum controllable temperature is 85 degrees F (29 degrees C).

Decrease Temperature

To decrease the temperature:

- observe the actual temperature
- push and hold the units selector until the temperature display begins to flash
- continue holding the COOLER arrow until the target temperature is reached

Note: Do not expect an immediate change in the temperature.

Note: Minimum controllable temperature is 65 degrees F (18 degrees C).

Oxygen System

[Option shown: Chemical oxygen - 12 minutes]

[Option: Chemical oxygen - 22 minutes; Gaseous oxygen system]

The crew rest oxygen system is a chemical oxygen generator system which provides oxygen for approximately 12 minutes.

The oxygen masks in the bunks will drop automatically in the event of a decompression.

Each mask oxygen valve is held closed by a pin inserted into the valve. Pulling on the mask withdraws the pin, causing the mask oxygen valve to open and oxygen to flow to that mask.

The oxygen masks may be manually released by inserting a hair pin or thin rod into the hole of the oxygen compartment cover.

Note: When the oxygen masks deploy, the green oxygen indicator light in the common area illuminates.

Note: Cabin depressurization is indicated by a continuous alarm horn sounding in the crew rest area.

Decompression

If a cabin decompression occurs during cruise:

- a decompression (continuous) horn sounds in the crew rest area
- in the door 3 upper crew rest common area, the green oxygen indicator light, located above the stair, will illuminate

The oxygen masks located above the bunks and seats will automatically deploy when the cabin altitude is above 13,500 feet. Oxygen flow is available when the mask or yellow streamer attached to the mask is pulled.

Crew rest occupants should immediately don one of the PSU or bunk service unit oxygen masks, move to an unoccupied position, and fasten the seat/bunk lap belt.

WARNING: It is acceptable to reach over a seat/bunk occupant to obtain an open/unused oxygen mask to prevent oxygen deprivation / light-headedness when moving to an unoccupied position.

Evacuate the upper crew rest area when directed by the flight crew.

Note: Prior to evacuating the upper crew rest area, push the HORN SHUT OFF switch (located in the crew rest common area). This will silence the decompression alarm horns in the overhead crew rest area.

Crew Rest Smoke Detection System Operation

Smoke detectors with an integral alarm horn are installed in the crew rest area:

- two smoke detectors are installed in the common area
- one smoke detector is installed in each bunk area

Note: Smoke detection is annunciated by a pulsing alarm horn sounding in the crew rest area and the entrance enclosure.

If smoke is detected in the door 3 upper crew rest area:

- on the flight deck:
 - the master caution light illuminates
 - an aural caution alarm sounds
 - a SMOKE REST UPR DR 3 Engine Indication and Crew Alerting System (EICAS) caution message is displayed
- in the crew rest area:
 - the respective smoke detector alarm indicator light illuminates
 - the pulsing smoke detection system alarm horns sound
 - all area lights illuminate
 - the crew rest area air supply valves are closed and the area smoke evacuation valves are opened
- at the entrance main control panel:
 - an alarm horn sounds
 - the AIRFLOW OFF light illuminates
- in the passenger cabin:
 - the amber reset light above the entrance enclosure door flashes
 - a SMOKE DETECTED DR3 UPR REST message appears on the cabin management system control panels
- the cabin master call lights flash

Continue to monitor the area until the smoke detector red alarm indicator light extinguishes.

Once the smoke clears, the red alarm indicator light extinguishes, the smoke detector is sensitive to smoke again.

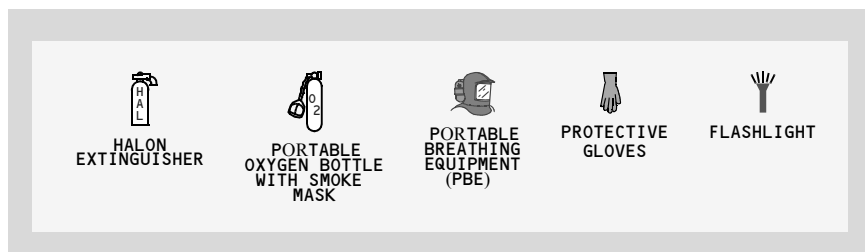
Note: When the smoke detector has been activated, lingering smoke in the detector sensor may cause reactivation. Blowing air into the detector sensor (the small screen cutout on the side of the cube extending from the unit) may clear lingering smoke.

Emergency Equipment

Door 3 upper crew rest emergency equipment includes:

- halon fire extinguishers (2)
- portable breathing equipment (PBE) (4)
- flashlight (1)

Emergency Equipment Symbols

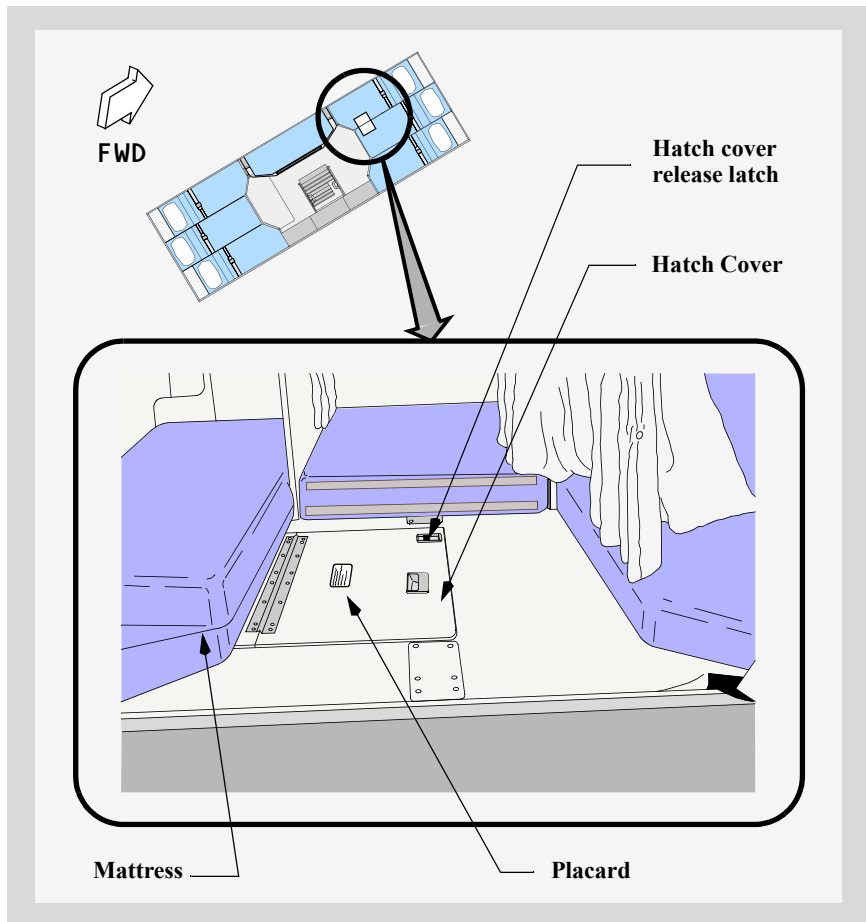




Evacuation using the Emergency Hatch

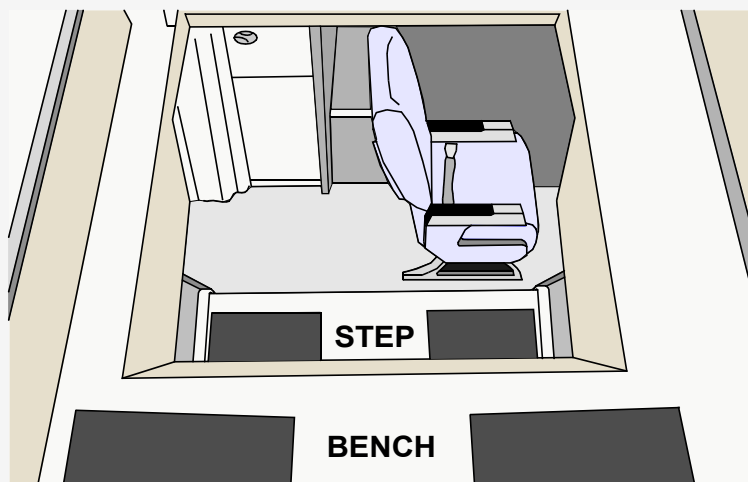
The primary evacuation route is through the entrance enclosure.

If the main entrance is unusable, evacuation is possible through the emergency hatch located between bunks 1 and 2.

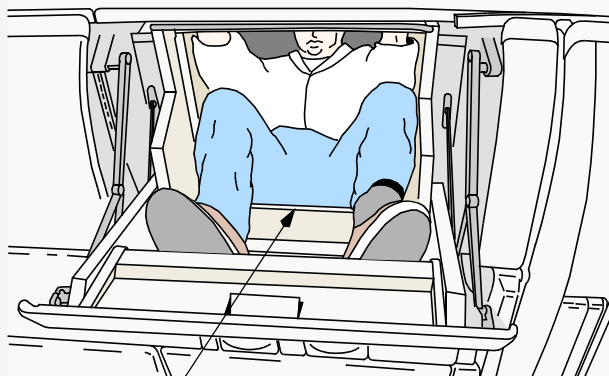


For egress:

- lift and remove the mattress pads
 - Note:** Stow the mattress pad where it can not obstruct emergency hatch or the aisle.
- unlatch and raise upper bunk escape hatch cover
- unlatch lower hatch
- command passengers in immediate area to move clear of evacuation area

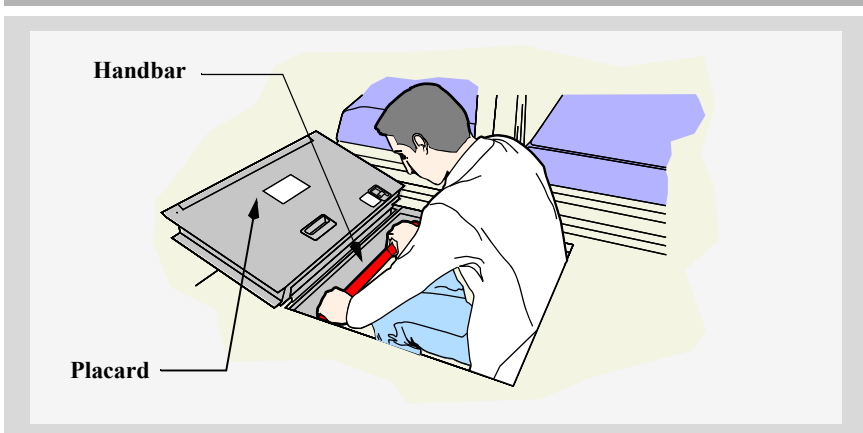


- sit on bunk facing placard
- lower legs into hatch opening

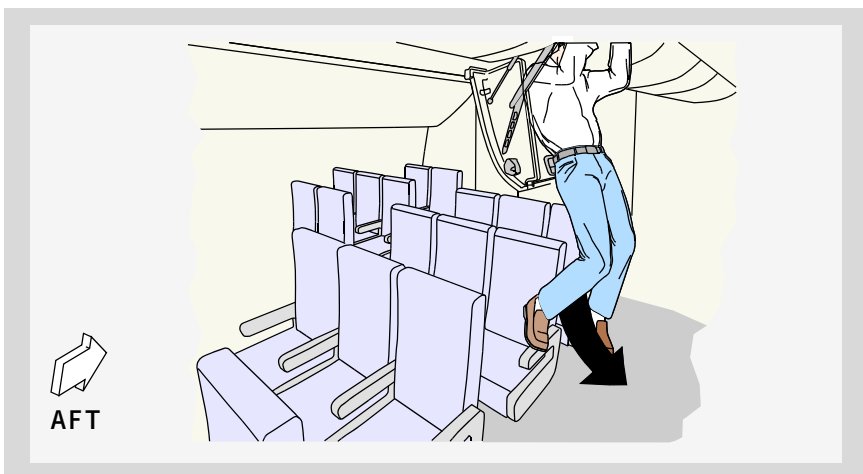


Bench

- sit on bench



- reach out and grab the handbar
 - keep elbows close to sides



- use step on lower hatch to climb/swing down to main deck
 - use the seat armrest to assist in maintaining balance as necessary

WARNING: During exit to the main deck, stepping on the seat back may cause the seat back to fold forward. If this occurs, the crew member may lose balance and hand grip, resulting in personal injury.

- close the lower hatch when evacuation is complete

WARNING: If the emergency hatch was used for crew evacuation, the lower hatch must be closed to help prevent the spread of smoke or fire.

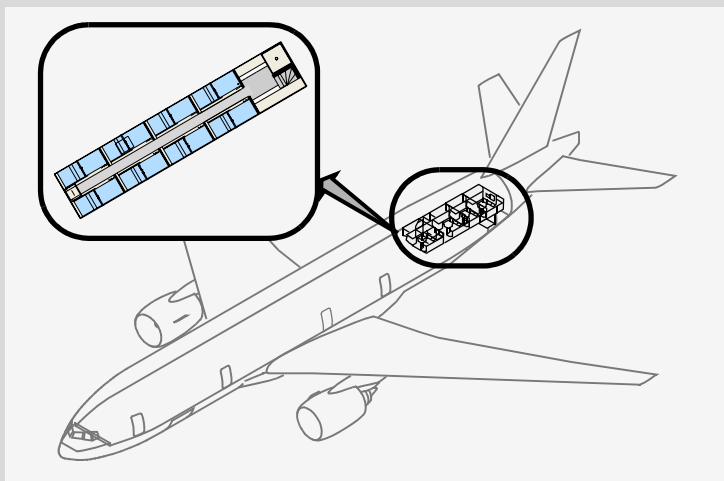
This Section Applies to WY350

Door 5 Upper Crew Rest

Note: The crew rest area should not be occupied during taxi, takeoff, or landing operations.

A door 5 upper crew rest area is located in the aft part of the airplane in the overhead between doors 4 and 5. Entry into the area is through an enclosure located in the passenger cabin across from door 5L.

The area has its own smoke detection system but no fire extinguishing system.



Occupancy

The door 5 upper crew rest is to be occupied by crew members trained in the use of the crew rest evacuation routes, fire fighting procedures and depressurization procedures.

Note: A placard is installed indicating any door 5 upper crew rest area occupancy restrictions.

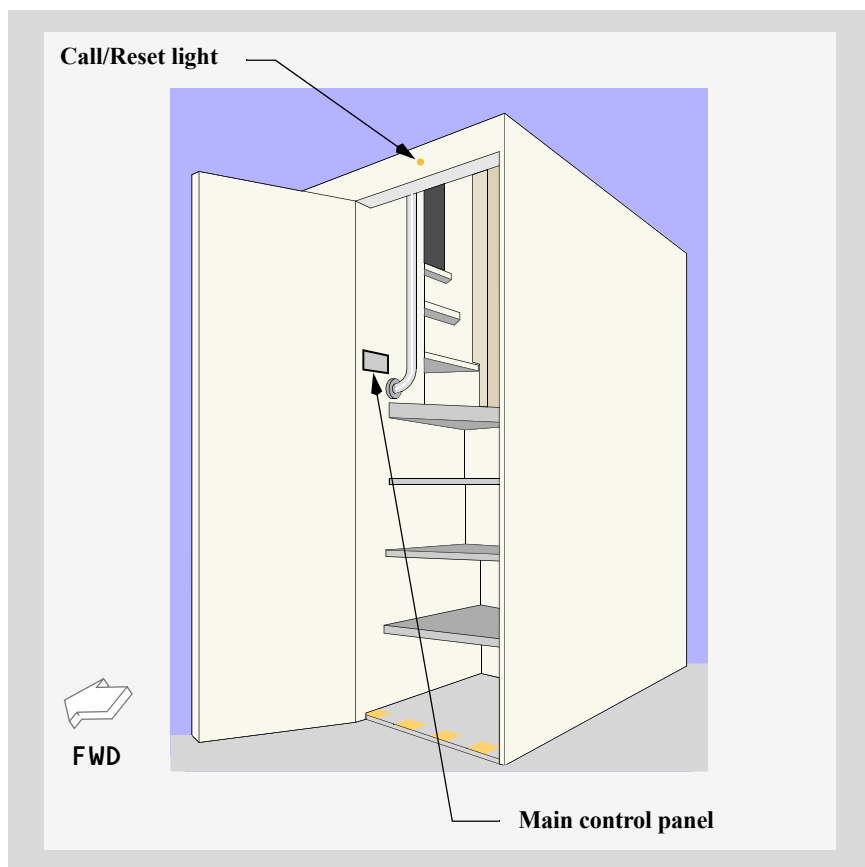
WARNING: The upper crew rest area should not be occupied when the amber AIRFLOW OFF light is illuminated.

Entrance Enclosure

Entry into the area is through an enclosure located in the passenger cabin across from door 5L. The entrance to the crew rest area has the same external appearance as a lavatory, but is placarded for crew use.

The door should remain closed and locked at all times.

The entrance enclosure contains the main control panel.



An amber call/reset light is mounted on the exterior wall above the entrance door. When smoke is detected in the area, the light flashes. The light will illuminate steady when the attendant call button on a passenger control unit (PCU) inside the area has been pushed.

Conditioned air is used to provide temperature control and ventilation to the door 5 upper crew rest area. When using the area, conditioned air flow must be available. An AIRFLOW OFF light on the main control panel in the entrance enclosure illuminates when conditioned air is not available.

Before entering the crew rest area, ensure that conditioned air flow is available. Verify that the AIRFLOW OFF light on the control panel in the entrance enclosure is not illuminated.

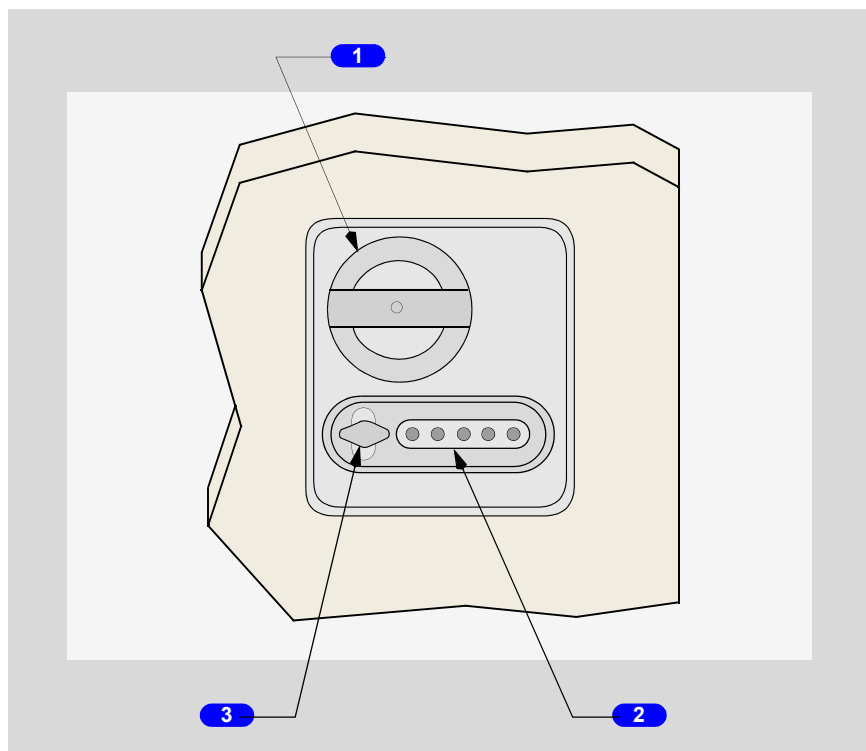
Note: The AIRFLOW OFF light will be illuminated when the airplane is below 25,000 feet.

Note: If the airplane is above 25,000 feet and the AIRFLOW OFF light is illuminated, pushing the AIRFLOW / SMOKE RESET switch resets the conditioned air system.

WARNING: If the AIRFLOW OFF light remains illuminated after the AIRFLOW / SMOKE RESET switch has been pushed, the door 5 upper crew rest area should not be occupied.

Entrance Enclosure Door Lock

A keyless door lock is installed on the entrance to the crew rest area.



1 Door handle

2 5 button keypad

3 Reset knob

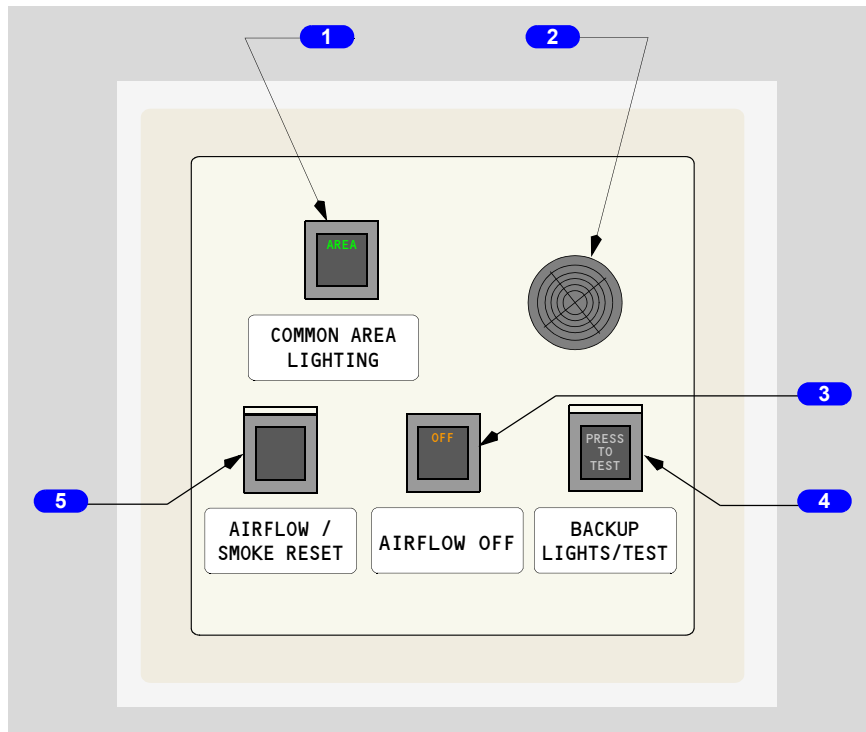
Door Lock Operation

To unlock the door, press the keypad buttons in the airline pre-programmed code and rotate the door handle in either direction to retract the door bolt. When the door handle is released, the bolt automatically returns to the latched position allowing the door to be closed without retracting the bolt.

Entrance Enclosure Control Panel

The door 5 upper crew rest area main control panel is located inside the entrance enclosure.

Main Control Panel



1 COMMON AREA LIGHTING Switch/Light

Push -

- turns the common area lights in the area on (light illuminated)/off (light extinguished)

2 Alert horn

Horn sounds when:

- airplane decompression occurs (continuous)
- smoke is detected in the overhead crew rest area (pulsating)

3 AIRFLOW OFF Light

Illuminated (amber) -

- area airflow exhaust valves are open or during smoke detection mode operations
- the area airflow is off

Note: A HI/LO chime will sound 5 times in the area whenever the air supply shutoff valve is commanded closed.

Note: The AIRFLOW OFF light will be illuminated when the airplane is below 25,000 feet or during smoke detection mode.

WARNING: The upper crew rest area should not be occupied when the amber AIRFLOW OFF light is illuminated.

WARNING: The overhead crew rest area should not be occupied when the amber AIRFLOW OFF light is illuminated.

4 BACKUP LIGHTS/TEST Switch/Light

Guarded switch/light.

Push - illuminated (white) -

- turns the emergency lights in the area on (light illuminated)/off (light extinguished)

Push and hold (2 seconds)

- the emergency lights in the area turn on for approximately one minute

5 AIRFLOW / SMOKE RESET Switch

Guarded switch.

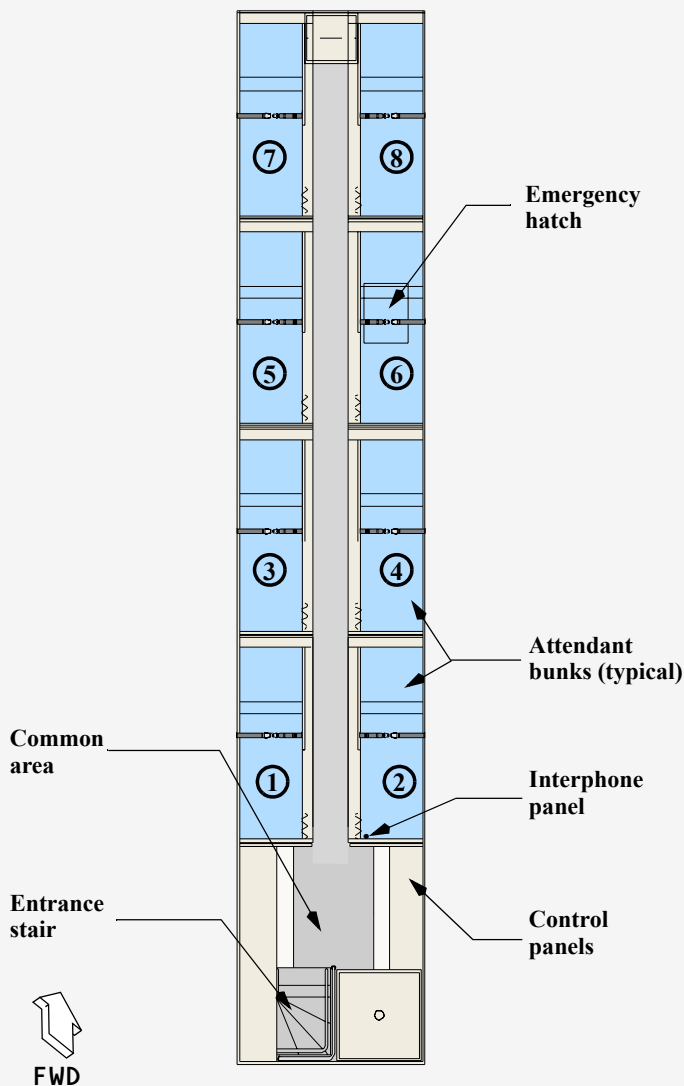
Push and hold (2 seconds)

- resets the airflow to the area
- resets aft galley electrical power

Note: In airplanes with a door 1 upper crew rest and a door 5 upper crew rest, both AIRFLOW / SMOKE RESET switches must be pushed to ensure proper restoration of the aft galley power.

Note: The AIRFLOW / SMOKE RESET switch is operative only when the airplane is on the ground or above 25,000 feet.

Crew Rest Layout

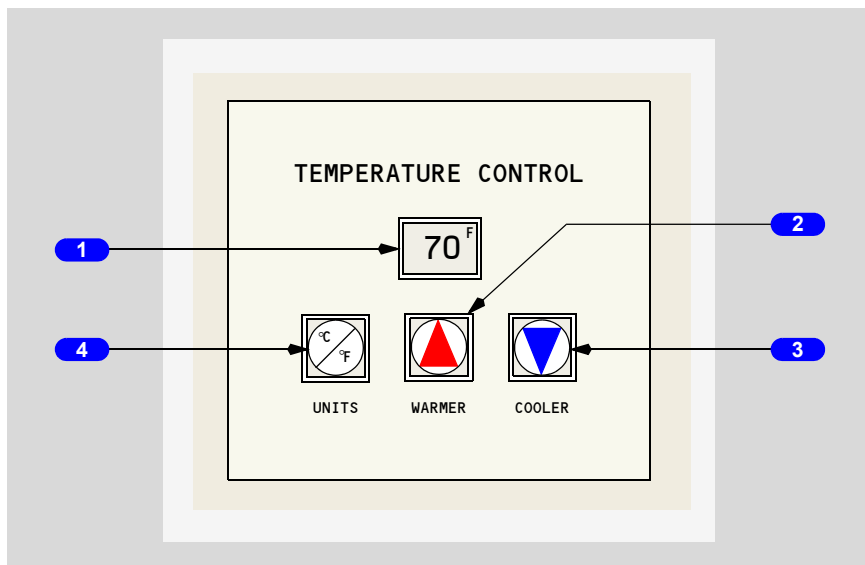


The door 5 upper crew rest area contains the following:

- common area containing:
 - control/warning panels
 - a lighting panel
 - a temperature control panel
 - interphone handset (1)
- 8 flight attendant bunks
- passenger control units (PCUs)
- emergency hatch
- smoke detectors
- emergency equipment

Temperature Control System

Temperature Control Panel



1 Temperature Display

Displays -

- current ambient air temperature in degrees F or C

Flashing -

- new temperature set point when warmer or cooler arrows are pushed

2 WARMER Arrow

Push -

- increases temperature in crew rest area when the temperature display is flashing

Note: Push and hold the WARMER arrow until the temperature display flashes. This allows the target temperature to be changed using the arrow.

3 COOLER Arrow

Push -

- decreases temperature in crew rest area when the temperature display is flashing

Note: Push and hold the COOLER arrow until the temperature display flashes. This allows the target temperature to be changed using the arrow.

4 UNITS Selector

Push -

- toggles between degrees F and degrees C for display and temperature selection

Temperature Control System Operation

The temperature in the crew rest area is controlled by the temperature controller located in the common area. The temperature may be set between 65 degrees F (18 degrees C) and 85 degrees F (29 degrees C).

Note: The temperature control system is inoperative below 25,000 feet.

Increase Temperature

To increase the temperature:

- observe the actual temperature
- push and hold the WARMER arrow until the temperature display begins to flash
- continue holding the WARMER arrow until the target temperature is reached

Note: Do not expect an immediate change in the temperature.

Note: Maximum controllable temperature is 85 degrees F (29 degrees C).

Decrease Temperature

To decrease the temperature:

- observe the actual temperature
- push and hold the units selector until the temperature display begins to flash
- continue holding the COOLER arrow until the target temperature is reached

Note: Do not expect an immediate change in the temperature.

Note: Minimum controllable temperature is 65 degrees F (18 degrees C).

Oxygen System

[Option shown: Chemical oxygen - 12 minutes]

[Option: Chemical oxygen - 22 minutes; Gaseous oxygen system]

The crew rest oxygen system is a chemical oxygen generator system which provides oxygen for approximately 12 minutes.

The oxygen masks in the bunks will drop automatically in the event of a decompression.

Each mask oxygen valve is held closed by a pin inserted into the valve. Pulling on the mask withdraws the pin, causing the mask oxygen valve to open and oxygen to flow to that mask.

The oxygen masks may be manually released by inserting a hair pin or thin rod into the hole of the oxygen compartment cover.

Note: When the oxygen masks deploy, the green oxygen indicator light in the common area illuminates.

Note: Cabin depressurization is indicated by a continuous alarm horn sounding in the crew rest area.

Decompression

If a cabin decompression occurs during cruise:

- a decompression (continuous) horn sounds in the crew rest area
- in the door 5 upper crew rest common area, the green oxygen indicator light, located above the stair, will illuminate

The oxygen masks located above the bunks and seats will automatically deploy when the cabin altitude is above 13,500 feet. Oxygen flow is available when the mask or yellow streamer attached to the mask is pulled.

Crew rest occupants should immediately don one of the PSU or bunk service unit oxygen masks, move to an unoccupied position, and fasten the seat/bunk lap belt.

WARNING: It is acceptable to reach over a seat/bunk occupant to obtain an open/unused oxygen mask to prevent oxygen deprivation / light-headedness when moving to an unoccupied position.

Evacuate the upper crew rest area when directed by the flight crew.

Note: Prior to evacuating the upper crew rest area, push the HORN SHUT OFF switch (located in the crew rest common area). This will silence the decompression alarm horns in the overhead crew rest area.

Crew Rest Smoke Detection System Operation

Smoke detectors with an integral alarm horn are installed in the crew rest area:

- two smoke detectors are installed in the common area
- two smoke detectors are installed in the crew rest aisleway
 - one smoke detector is installed between the bunks approximately half-way down the aisleway
 - one smoke detector is installed in the aisleway between the bunks near the forward closet
- one smoke detector is installed in each bunk area

Note: Smoke detection is annunciated by a pulsing alarm horn sounding in the crew rest area and the entrance enclosure.

If smoke is detected in the door 5 upper crew rest area:

- on the flight deck:
 - the master caution light illuminates
 - an aural caution alarm sounds
 - a SMOKE REST UPR DR5 Engine Indication and Crew Alerting System (EICAS) caution message is displayed
- in the crew rest area:
 - the respective smoke detector alarm indicator light illuminates
 - the pulsing smoke detection system alarm horns sound
 - all area lights illuminate
 - the crew rest area air supply valves are closed and the area smoke evacuation valves are opened
- in the passenger cabin:
 - the amber light above the entrance enclosure door flashes
 - a SMOKE DETECTED DR5 UPR REST message appears on the cabin management system control panels
 - aft galley electrical power is removed
- the cabin master call lights flash

Continue to monitor the area until the smoke detector red alarm indicator light extinguishes.

Once the smoke clears, the red alarm indicator light extinguishes, the smoke detector is sensitive to smoke again.

Note: When the smoke detector has been activated, lingering smoke in the detector sensor may cause reactivation. Blowing air into the detector sensor (the small screen cutout on the side of the cube extending from the unit) may clear lingering smoke.

Emergency Equipment

Door 5 upper crew rest emergency equipment includes:

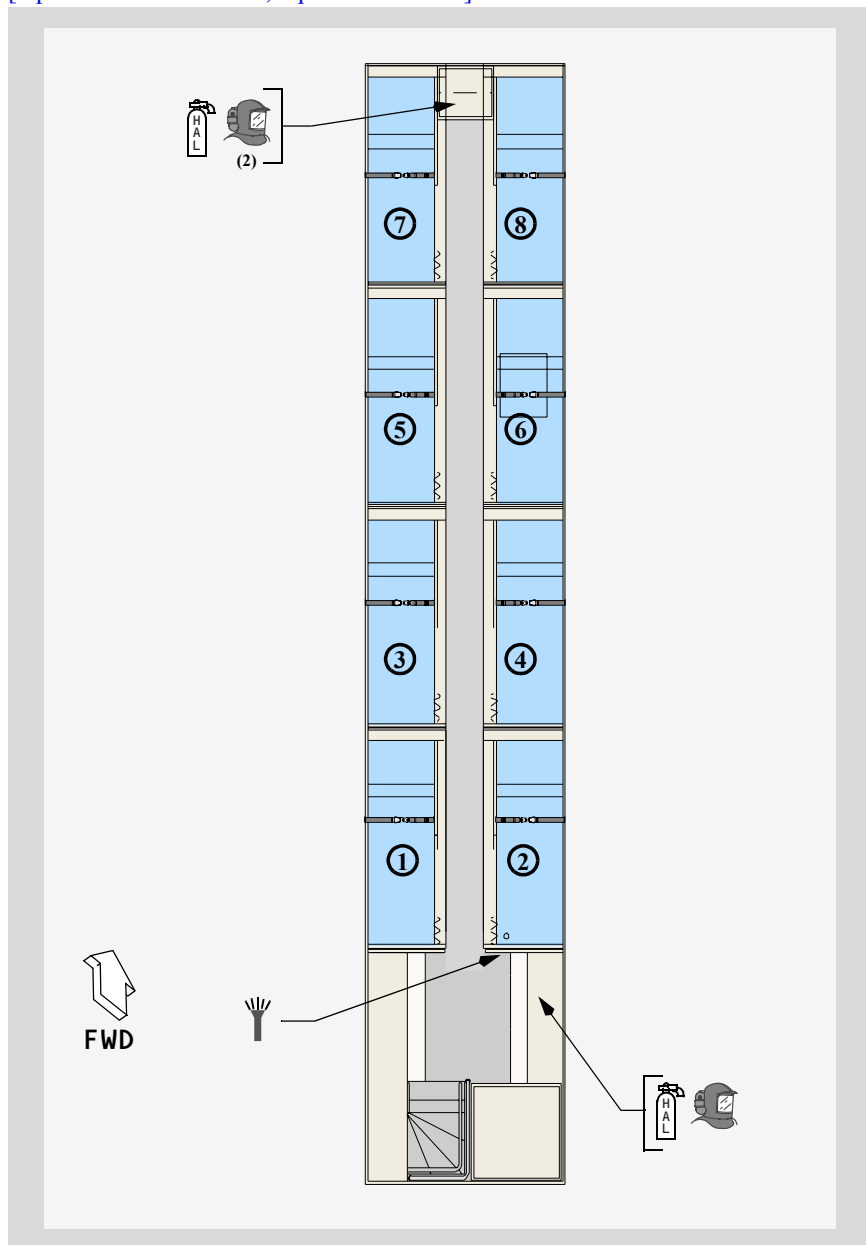
- halon fire extinguishers (2)
- portable breathing equipment (PBE)
- portable breathing equipment (PBE) (3)
- flashlight (1)

Emergency Equipment Symbols



Emergency Equipment Location

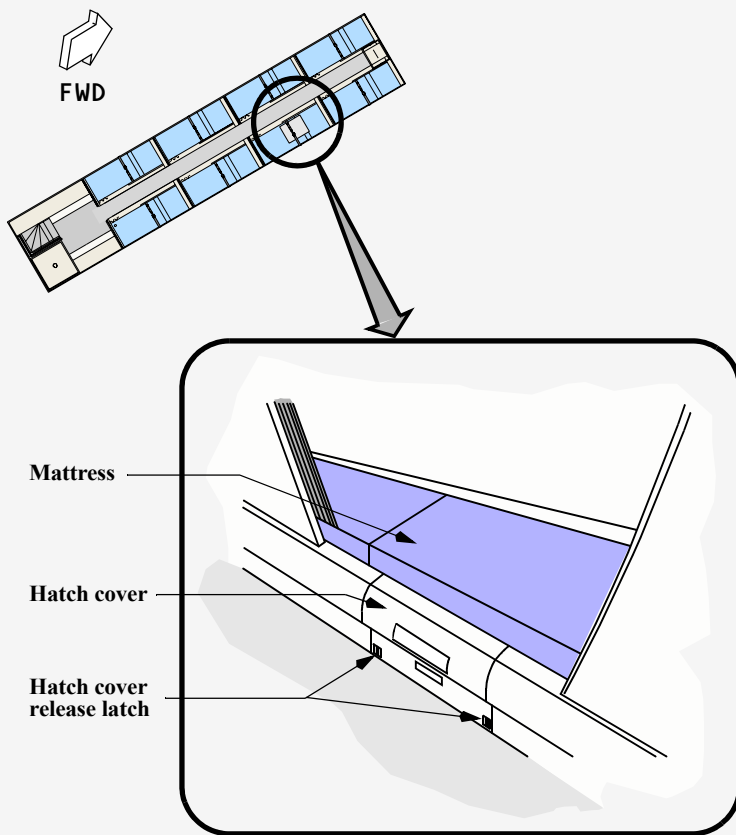
[Option shown: 8 bunks; Option: 10 bunks]



Evacuation using the Emergency Hatch

The primary evacuation route is through the entrance enclosure.

If the main entrance is unusable, evacuation is possible through the emergency hatch located under bunk 6.

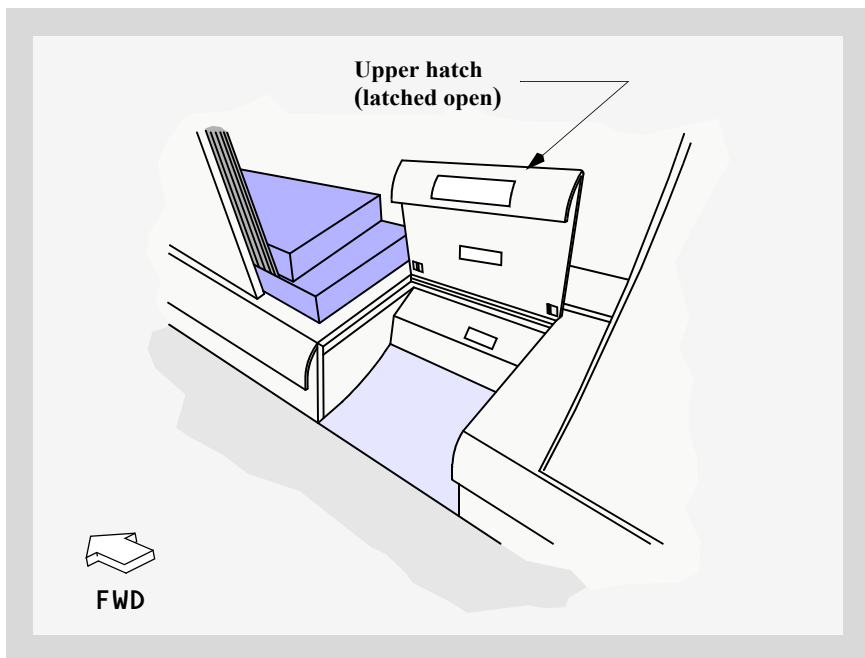


For egress:

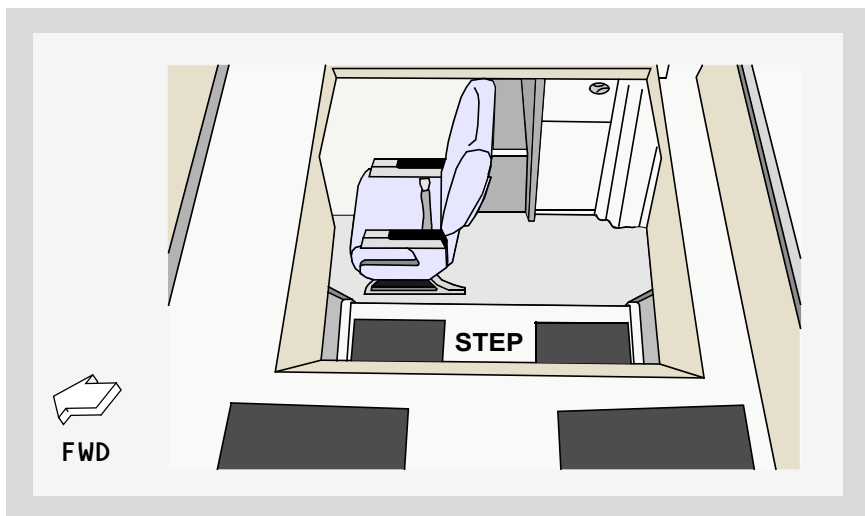
- lift and remove the mattress pad

Note: Stow the mattress pad where it can not obstruct emergency hatch or the aisle.

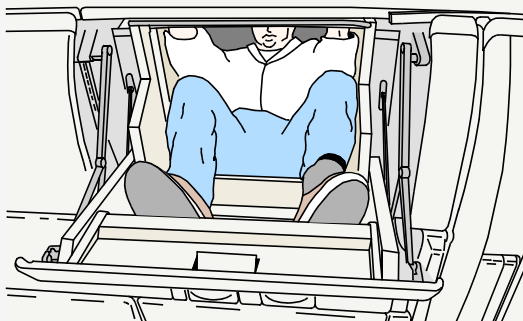
- unlatch and raise upper hatch cover



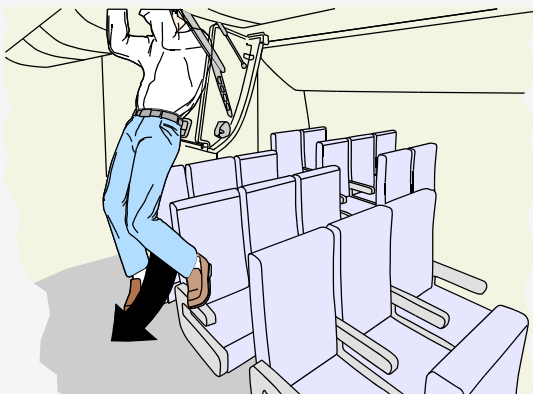
- unlatch lower hatch
- command passengers in immediate area to move clear of evacuation area



- sit on floor facing outboard and lower legs into hatch opening



- reach out and grab the outboard handhold
- keep elbows close to sides



- use step on lower hatch to climb/swing down to main deck
- exit to main deck

WARNING: During exit to the main deck, stepping on the seat back may cause the seat back to fold forward. If this occurs, the crew member may lose balance and hand grip, resulting in personal injury.

- close the lower hatch when evacuation is complete

WARNING: If the emergency hatch was used for crew evacuation, the lower hatch must be closed to help prevent the spread of smoke or fire.

**Airplane General, Emergency
Equipment, Doors, Windows
Lower Crew Rest****Chapter 1****Section 48**

This Section Applies to WY250

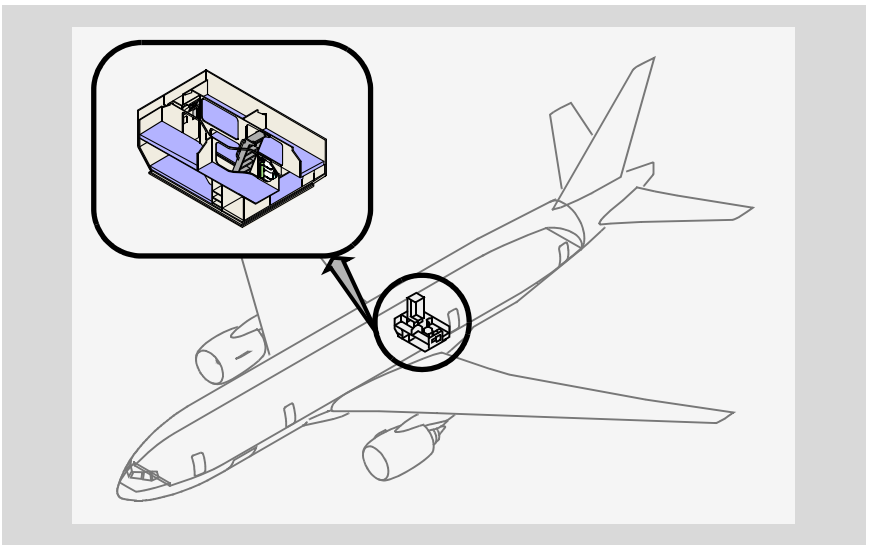
Introduction

This section describes the lower crew rest area, including:

- location and entry enclosure
- control panels
- layout
- fire protection

Lower Crew Rest (LCR) Compartment

Note: The LCR should not be occupied during taxi, takeoff, or landing operations.



A lower crew rest (LCR) compartment is located in the forward section of the aft cargo compartment. The entrance enclosure to the compartment is located near the center aisle at door 3. Air conditioning is only supplied to the LCR when airplane altitude is 25,000 feet or higher, and the main entry hatch is open.

The LCR compartment has its own smoke detection and fire extinguishing system.

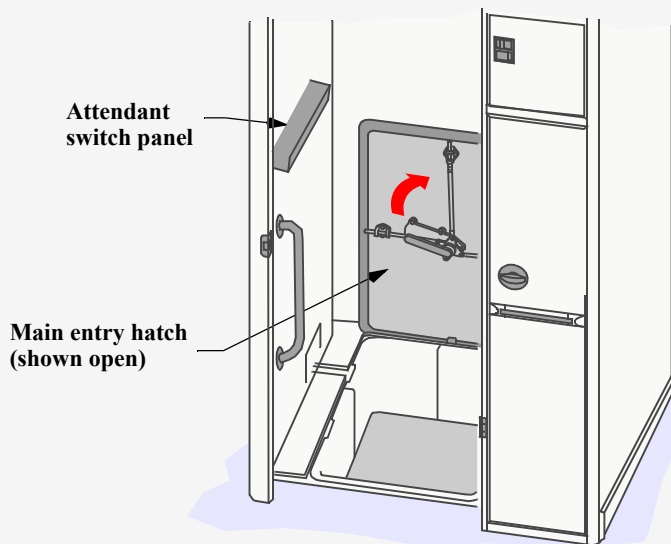
Note: Before entering the LCR, ensure that conditioned air flow is available. Verify that the AIR FLOW OFF light on the attendant switch panel (ASP) in the entrance enclosure is not illuminated.

WARNING: The LCR should not be occupied when the amber AIR FLOW OFF light on the compartment attendant control panel is illuminated.

Entrance Enclosure

The entrance enclosure contains the LCR attendant switch panel and the main hatch.

When the compartment is occupied, the hatch must be open.



Entrance Enclosure (shown with door removed)

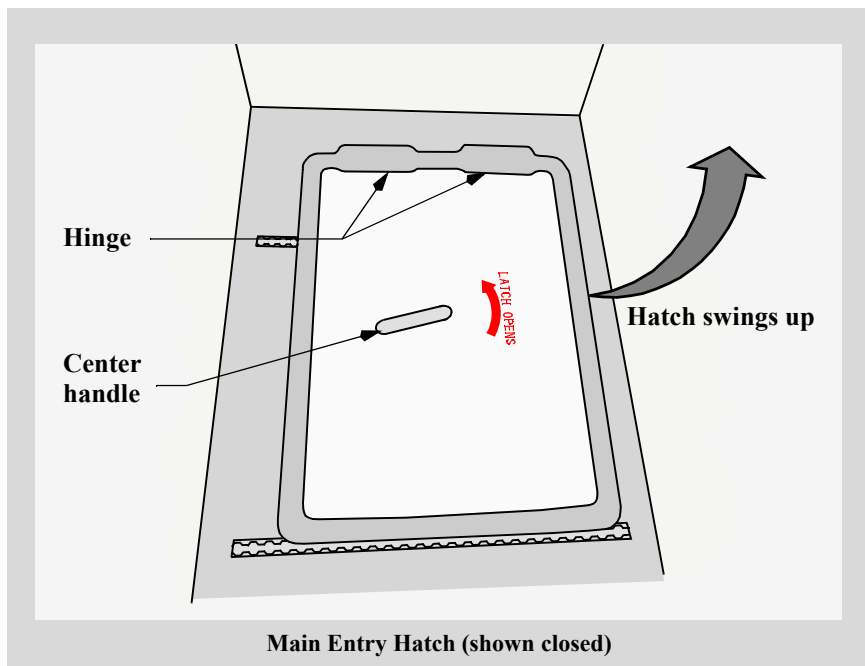
Main Entry Hatch

The main entry hatch to the LCR is located inside the entrance enclosure.

Note: The main entry hatch into the LCR must be closed during taxi, takeoff and landing.

Conditioned air is supplied to the lower crew rest compartment when the airplane has reached an altitude of 25,000 feet or higher, and the main entry hatch is open. The LCR should be occupied only when the airplane has reached an altitude of 25,000 feet or higher, and the main entry hatch is open.

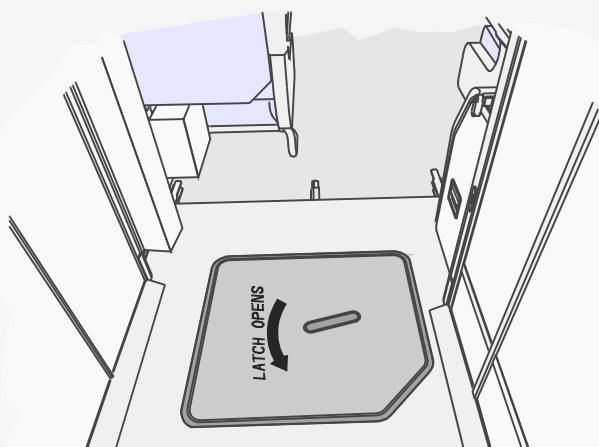
WARNING: Closing the main entry hatch shuts off air flow to the lower crew rest compartment.



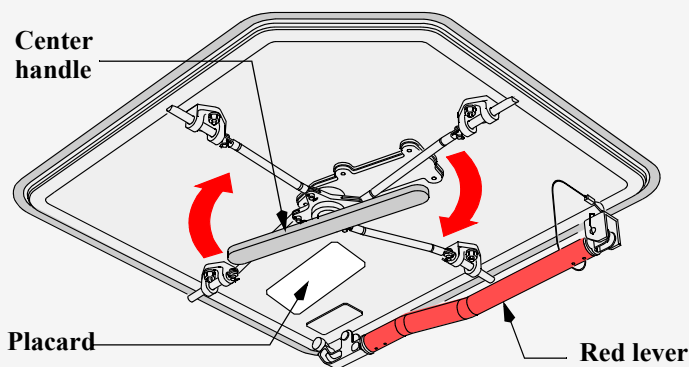
CAUTION: The main hatch must be closed when the LCR is unoccupied.

Emergency Hatch

The primary evacuation route is through the main hatch in the entrance enclosure. If the main hatch is unusable, evacuate through the emergency hatch. To use the emergency hatch, follow the placarded instructions.



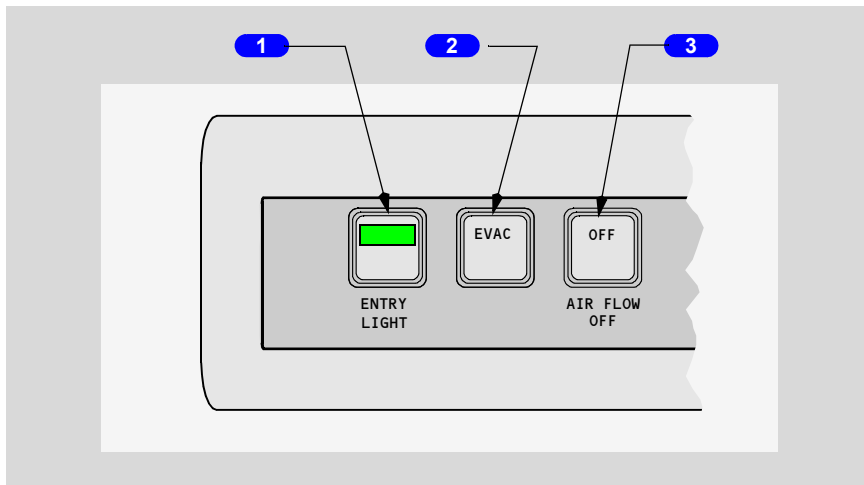
Emergency Hatch
(in passenger cabin with carpet folded back)



Emergency Hatch
(inside compartment looking up)

Lower Crew Rest Attendant Switch Panel

The LCR compartment attendant switch panel is located inside the entrance enclosure. The panel has the switches necessary to arm and discharge the fire extinguishing system.



1 ENTRY LIGHT

Illuminated green at all times.

Push –

- turns on the lights in entrance enclosure ceiling and near the stairs

2 Evacuation (EVAC) Light

Illuminated (red) –

- smoke has been detected in the LCR, or
- the aft cargo compartment fire extinguishing system ARM switch is selected

WARNING: The LCR should not be occupied when the EVAC light is illuminated.

3 AIR FLOW OFF Light

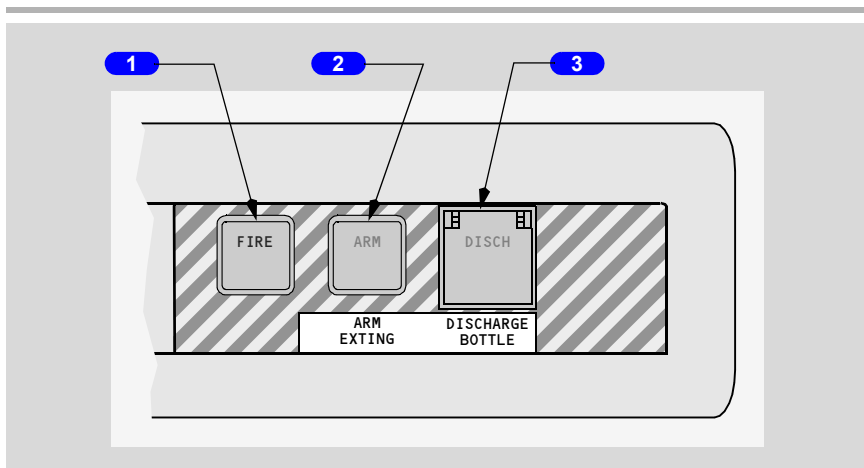
Illuminated (amber) – the valve supplying air to the LCR is commanded closed.

The air supply shutoff valve will close if:

- airplane altitude is less than 25,000 feet
- the main compartment hatch is closed
- smoke is detected in the LCR
- the LCR fire extinguishing system is armed
- the aft cargo fire extinguishing system is armed, or
- if the airplane is on the ground and the left pack is on

Note: A HI/LO chime will sound 5 times in the compartment whenever the air supply shutoff valve is commanded closed.

WARNING: The LCR should not be occupied when the amber AIR FLOW OFF light is illuminated.



1 FIRE Light

Illuminated (red) –

- smoke has been detected in the LCR, or
- the FIRE TEST switch is pushed

2 ARM Extinguisher (EXTING) Switch

Push –

- illuminates the amber ARM light
- arms the fire extinguishing system, and
- causes the air supply valve to close

3 DISCHARGE BOTTLE Switch

Push –

- discharges the halon fire extinguisher into the LCR after the ARM switch has been selected

DISCH illuminated (amber) –

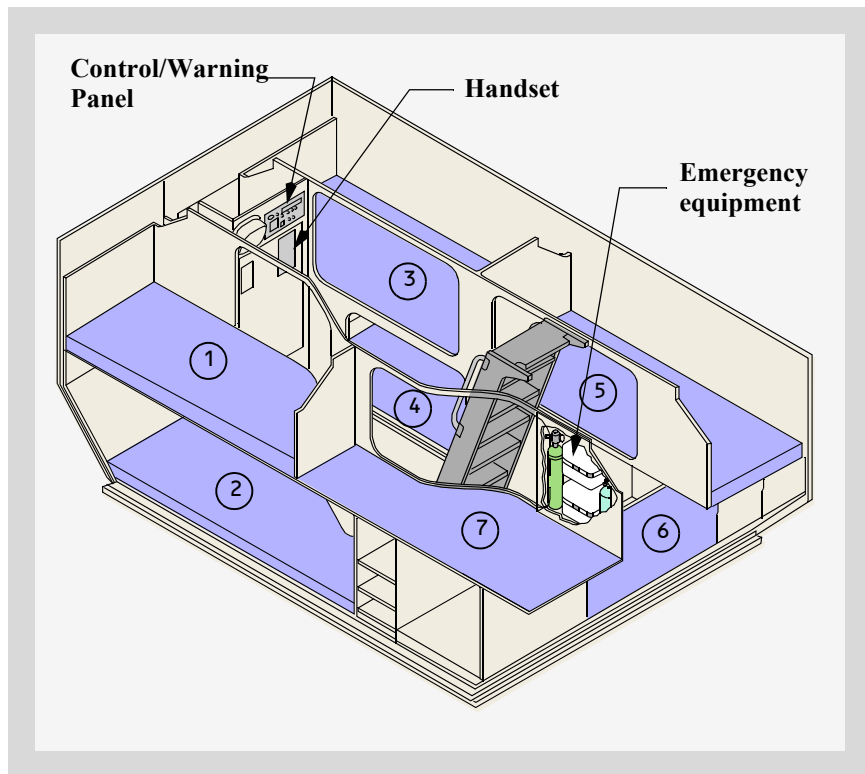
- illuminates within 15 seconds after being pushed to indicate that extinguisher bottle has been discharged.
- extinguisher bottle pressure is low

Note: Extinguisher bottle low pressure occurs if the bottle has been discharged, or there is a leak in the extinguisher bottle.

Note: A HI/LO chime will sound 5 times in the compartment whenever the low pressure switch is activated on the halon bottle.

LCR Layout

[Option shown: 7 bunks; Option: 6 bunks]



The lower crew rest compartment contains the following:

- bunks (circled numbers 1 through 7)
- interphone handset (1)
- emergency hatch
- passenger service unit (PSU) at each bunk
- control/warning panel
- emergency equipment

LCR Fire Protection

If smoke is detected in the LCR:

- on the flight deck:
 - an aural caution sounds
 - the EICAS caution message SMOKE CREW REST LWR is displayed
- in the LCR compartment:
 - an intermittent horn sounds
 - Note:** The compartment smoke horn is intermittent. The compartment oxygen horn is continuous.
 - the EVAC MODULE light illuminates red
 - the AIR FLOW OFF light illuminates amber
 - the LCR air supply shutoff valve is closed and a chime sounds 5 times
- in the LCR enclosure:
 - the EVAC light illuminates red
 - the AIR FLOW OFF light illuminates amber
 - the FIRE light illuminates red
 - the fire horn sounds
 - the LCR smoke detector integral horn sounds
- in the passenger cabin
 - an amber light above the entrance enclosure door flashes
 - a continuous high chime sounds throughout the cabin
 - the cabin attendant master call lights flash
 - a SMOKE DETECTED LCR message appears on the cabin management system control panels

Fire Extinguishing System

The fire extinguishing system in the LCR compartment consists of one halon bottle located inside the compartment. The halon bottle's discharge circuit is monitored during each flight. In the event of a leak, the DISCH lights in the entrance enclosure and the compartment will illuminate and a HI/LO chime will sound 5 times in the module.

Fire Extinguishing Operation

To activate the LCR fire extinguishing system:

- arm the fire extinguishing system
 - push the ARM switch on the attendant switch panel in the LCR entrance enclosure
 - verify the ARM light illuminates red
- lift the guard and push the DISCH switch
 - verify the red DISCH light illuminates red within 15 seconds

**Airplane General, Emergency
Equipment, Doors, Windows
Doors, Windows, Seats****Chapter 1****Section 50**

Introduction

This section describes miscellaneous airplane systems, including:

- doors and windows
- flight deck seats

Doors and Windows

[\[777–200, 777–200ER, and 777-200LR\]](#)

The airplane has eight passenger entry doors, one flight deck door (the flight deck/cabin entry), and three cargo doors. It also has two center electrical and electronic (E/E) equipment access doors, one forward and one main.

[\[777F\]](#)

The airplane has two crew entry doors and four cargo doors. It also has two center electrical and electronic (E/E) equipment access doors, one forward and one main.

[\[777–300 and 777-300ER\]](#)

The airplane has eight passenger entry doors, two overwing exits, one flight deck door (the flight deck/cabin entry), and three cargo doors. It also has two center electrical and electronic (E/E) equipment access doors, one forward and one main.

CAUTION: Do not operate the entry or cargo doors with winds at the door of more than 40 knots. Do not keep doors open when wind gusts are more than 65 knots. Strong winds can cause damage to the structure of the airplane.

The flight deck number two windows, one on the left and one on the right, can be opened by the flight crew.

An EICAS message is displayed when an entry door, overwing exit, cargo door, access door, or flight deck window is not closed, latched, and locked.

Flight Deck Door

[\[Passenger\]](#)

The flight deck door meets requirements for resistance to ballistic penetration and intruder entrance. The door opens into the flight deck. When closed, the door locks when electrical power is available and unlocks when electrical power is removed. A viewing lens in the door allows observation of the cabin. The door can be manually opened from the flight deck by turning the door handle.

The door incorporates a deadbolt with a key lock. Rotating both concentric deadbolt levers to the locked (horizontal) position prevents the cabin key from unlocking the door. Rotating only the forward deadbolt lever to locked allows the key to unlock the door.

The flight deck access system consists of an emergency access panel, a chime module, a door lock selector, two indicator lights, and an access system switch. The emergency access panel includes a six button keypad for entering the numeric emergency access code along with red, amber, and green lights. The red light illuminates to indicate the door is locked. When the correct emergency access code is entered, the amber light illuminates. The green light illuminates to indicate the door is unlocked.

Two indicator lights and a three position rotary door lock selector are located on the aft aisle stand. Illumination of the amber LOCK FAIL light indicates the door lock has failed or the access system switch is in the OFF position.

The emergency access code is used to gain access to the flight deck in case of pilot incapacitation. Annunciation of a flight deck chime and illumination of the amber AUTO UNLK light indicates the correct emergency access code has been entered and the door is programmed to unlock after a time delay. Selecting the DENY position on the door lock selector denies entry and prevents further keypad entry for several minutes. To allow entry, the selector is turned to the UNLKD position which unlocks the door while held in that position. If the emergency access code is entered and the pilot takes no action, the door unlocks after expiration of the time delay. Before the door unlocks, the chime sounds continuously and the AUTO UNLK light flashes.

By pressing "1" then "ENT" keys on the emergency access panel, the flight deck chime will sound (if programmed).

The door latch system incorporates a pressure rate-sensor that unlocks the door in the event of flight deck depressurization. Two hinged decompression panels open to equalize pressure in the event of cabin depressurization. Each panel opening has a security grill on the flight deck side.

Features are included to prevent a jammed door due to structural deformation. A lower break-away panel is attached to the main door section by interlocking extrusions and two shear pins. If sufficient upward force occurs, the pins will shear and the break-away panel will separate from the door. If the pins fail to shear, they can be retracted manually to aid in egress. An angled door jamb aids in forcing the door open into the flight deck in case of surrounding bulkhead deformation.

Flight Deck Number Two Windows

The flight deck number two windows can be opened on the ground or in flight. The flight deck number two windows can be used for emergency evacuation. The associated window lock lever locks or unlocks the window. With the window unlocked, rotating the window crank opens the window. To open the window:

- rotate the window lock lever aft to the open position
- crank the window to the full open position (the WINDOW NOT CLOSED placard is visible).

When closing the window, the window lock lever must be in the unlocked position. As the window approaches the full closed position, the force required on the crank increases. To close the window:

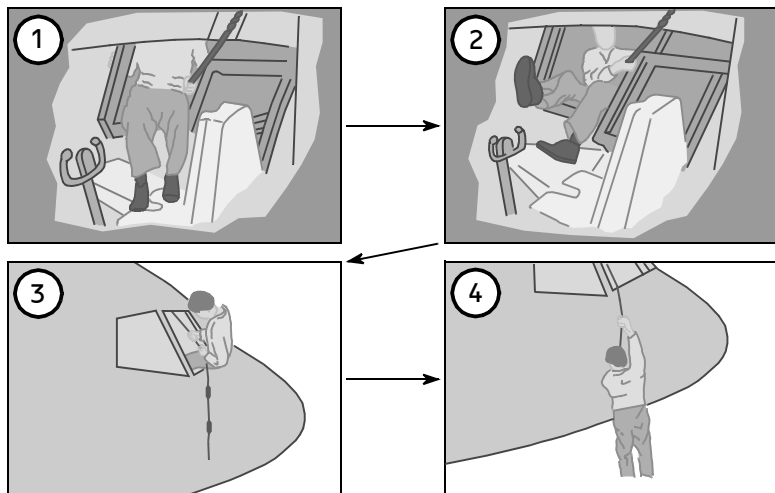
- crank the window to the full closed position (the WINDOW NOT CLOSED placard is not visible)
- rotate the window lock lever forward to the locked position.

The windows can be opened or closed in flight with minor flight deck consequences if the airplane is unpressurized. The force required to move the crank increases with airspeed. With the window open, voice, interphone, and radio audio may not be heard due to high noise levels. Prior communications arrangements with the controlling agency should be established before opening the window. The design provides an area of relatively calm air over the open window. Forward visibility can be maintained by looking out of the open window.

Escape ropes are attached to the airplane structure above both number two flight deck windows. The ropes are stowed in compartments above the pilot seats.

The EICAS advisory message WINDOW FLT DECK (L or R) or WINDOWS (both windows) is displayed if the window(s) are not closed and latched.

Flight Deck Window Emergency Egress



If the flight deck number two windows must be used for emergency egress, use the following procedure:

- open the window
- remove the bag containing the rope (above and aft of window)
- pull on rope to ensure it is securely attached
- throw the bag out the window (bag falls off)
- check the first rope handhold is green and is located in the window opening
- sit on the window sill with upper body outside
- exit in accordance with the above illustration.

CAUTION: Ensure the rope is securely fastened to the airplane.

Entry Doors

[\[777-200, 777-200ER, and 777-200LR\]](#)

The passenger entry doors are used to enter and exit the airplane, and also serve as emergency exits. There are no other cabin exits. The eight passenger entry doors are paired along the airplane fuselage. The doors are identified 1 through 4 left, and 1 through 4 right. The passenger entry doors can be opened or closed manually from inside or outside of the airplane.

[777-300 and 777-300ER]

The passenger entry doors are used to enter and exit the airplane, and also serve as emergency exits. The two overwing exit doors are only for use as emergency exits. The eight passenger entry doors and two overwing exit doors are paired along the airplane fuselage. The doors are identified 1 through 5 left, and 1 through 5 right. The doors can be opened or closed manually from inside or outside of the airplane.

[777F]

Crew entry doors 1L and 1R are used to enter and exit the airplane, and also serve as emergency exits. Either door can be opened or closed manually from inside or outside of the airplane.

The entry doors are translating, plug-type doors. During opening, the door first moves inward and upward, then translates outward and forward. Each door is held in the open position by a gust lock. The gust lock drops into a latch as the door nears its forward limit of travel. A window in each door allows observation outside of the airplane.

The overwing exit doors are translating, plug-type doors. Operation is the same as the entry doors.

Each door has a vent panel connected to the door handle. The vent is designed to prevent pressurization to an unsafe level if the door is not fully closed, latched, and locked. Forward rotation of the door handle past the latched position closes the vent. Initial aft door handle rotation opens the vent to equalize cabin and ambient pressure. At low differential pressure, the door handle can be rotated to allow the door to open fully. At high differential pressure, the vent can be partially opened; however, a mechanical interlock prevents door opening until the differential pressure is reduced. At very high differential pressure, the vent cannot be opened.

Entry Door Flight Lock

Each door handle is automatically locked when airspeed is greater than 80 knots. The flight lock allows limited door handle rotation sufficient to partially open the door vent, but prevents door opening. If electrical power is removed or fails, the flight lock is spring-loaded to the unlocked position.

Entry Door Slide/Raft

Emergency evacuation slide/raft and pneumatic door opening systems are contained in each entry door. Each door system has enough power to open the door unassisted, even if the airplane is not level because of any landing gear collapse condition. A slide/raft cover in the lower face of the door contains the slide/raft.

Overwing Escape Slide

[777-300 and 777-300ER]

An overwing escape slide assembly, consisting of a dual lane ramp with a dual lane slide, is contained in a exterior compartment in the wing body fairing. On activation of the overwing escape slide assembly, the inboard spoilers retract. An EICAS message is displayed if an overwing escape slide is not closed, latched, and locked.

WARNING: If door 3 is used during ditching, the door mode selector lever must be in DISARMED to allow the door to be opened without deploying the ramp/slide.

Emergency Exit Operation

[Option – ARMED/DISARMED Shown, AUTOMATIC/MANUAL or FLIGHT/PARK Optional]

Placing the mode select lever in the ARMED position:

- arms the emergency door opening system
- engages the girt bar on entry doors
- arms the escape slide/rafts

[777-300 and 777-300ER]

- arms the overwing escape slides

Once armed, moving the interior door handle to the open position operates the pneumatic opening actuator. The actuator drives the door open, and the slide automatically deploys and inflates.

The emergency door opening system and the slide/raft are automatically disarmed when the door is opened from the outside. If the mode select lever is in the ARMED position and the door is opened using the exterior door handle, the mode select lever automatically moves to DISARMED and the door opens without slide/raft deployment.

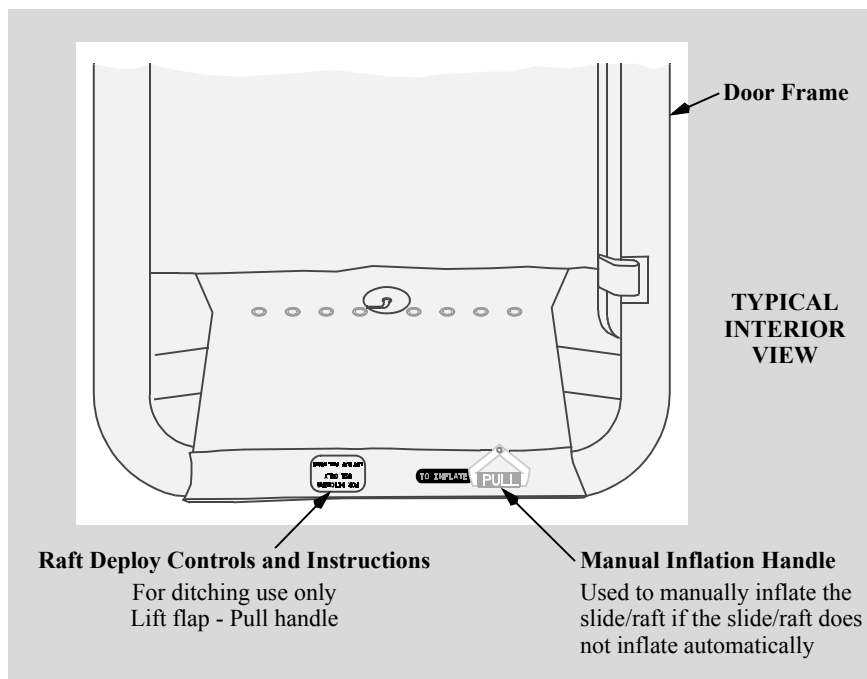
[Option - EICAS Door AUTO/MANUAL Memo Messages]

The following EICAS memo messages display the overall door mode select lever positions:

- DOORS AUTO (ARMED)
- DOORS MANUAL (DISARMED)
- DOORS AUTO/MANUAL (ARMED/DISARMED).

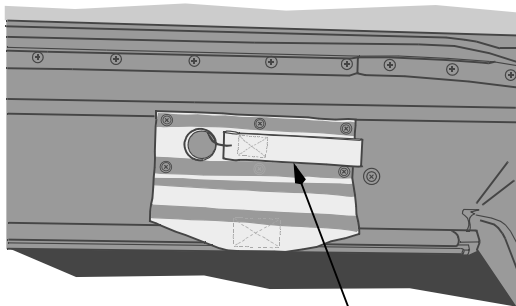
The DOORS AUTO/MANUAL message continues to be displayed for two seconds when it is being replaced by the DOORS AUTO or DOORS MANUAL message. During this time, both the DOORS AUTO/MANUAL message and the message replacing it can be displayed.

Slide/Raft Deployed



Door 3 Slide Manual Inflation Handle

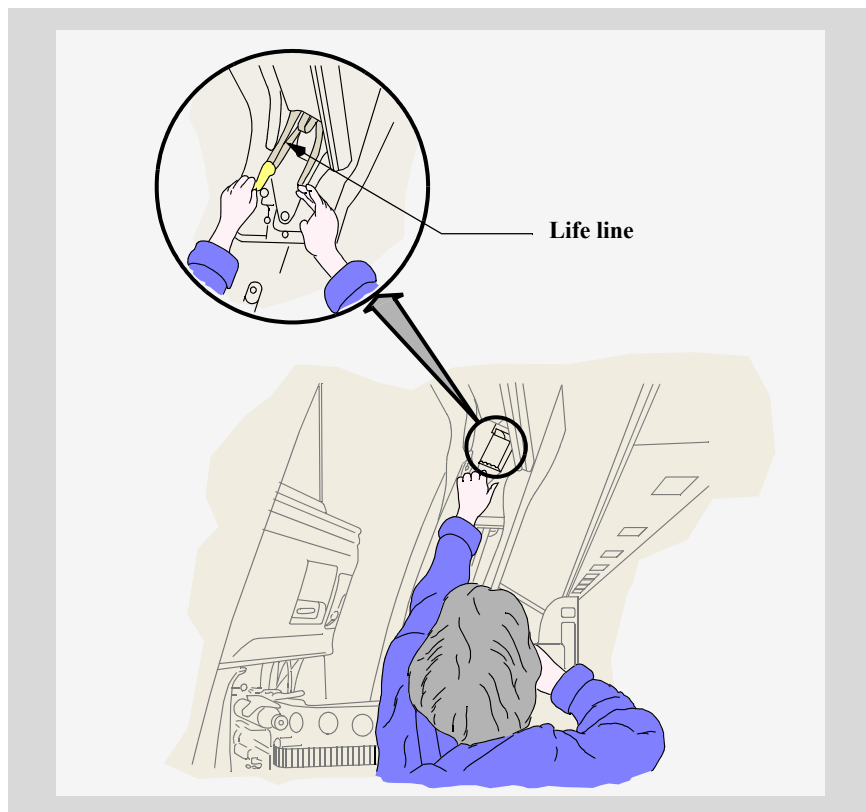
[777-300 and 777-300ER]

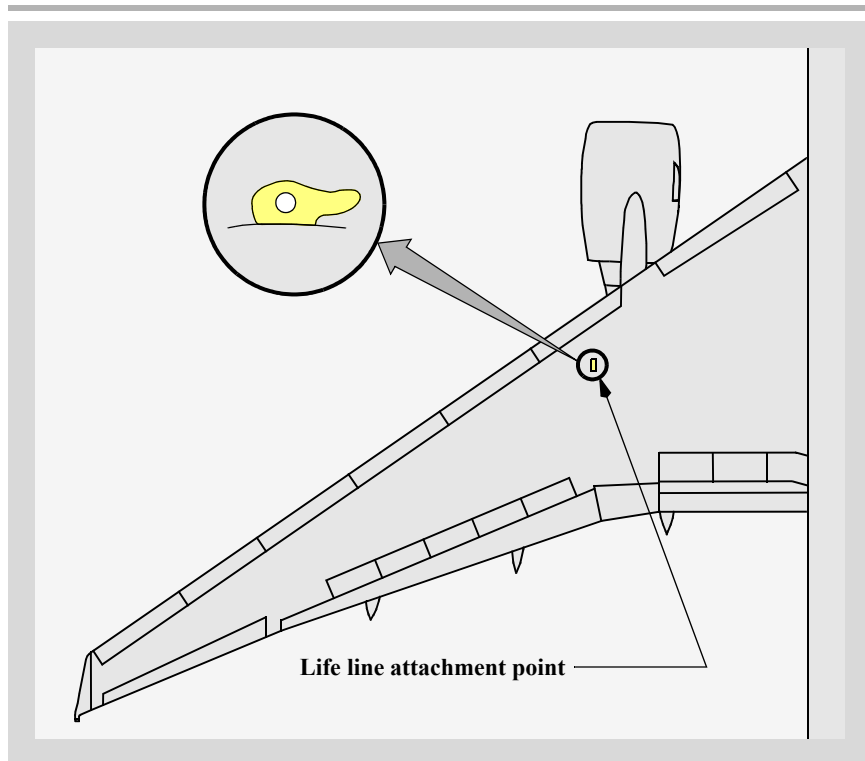


Manual Inflation Handle
Pull to manually inflate slide if
it does not inflate automatically

Door 3 Life Line

[777-300 and 777-300ER]

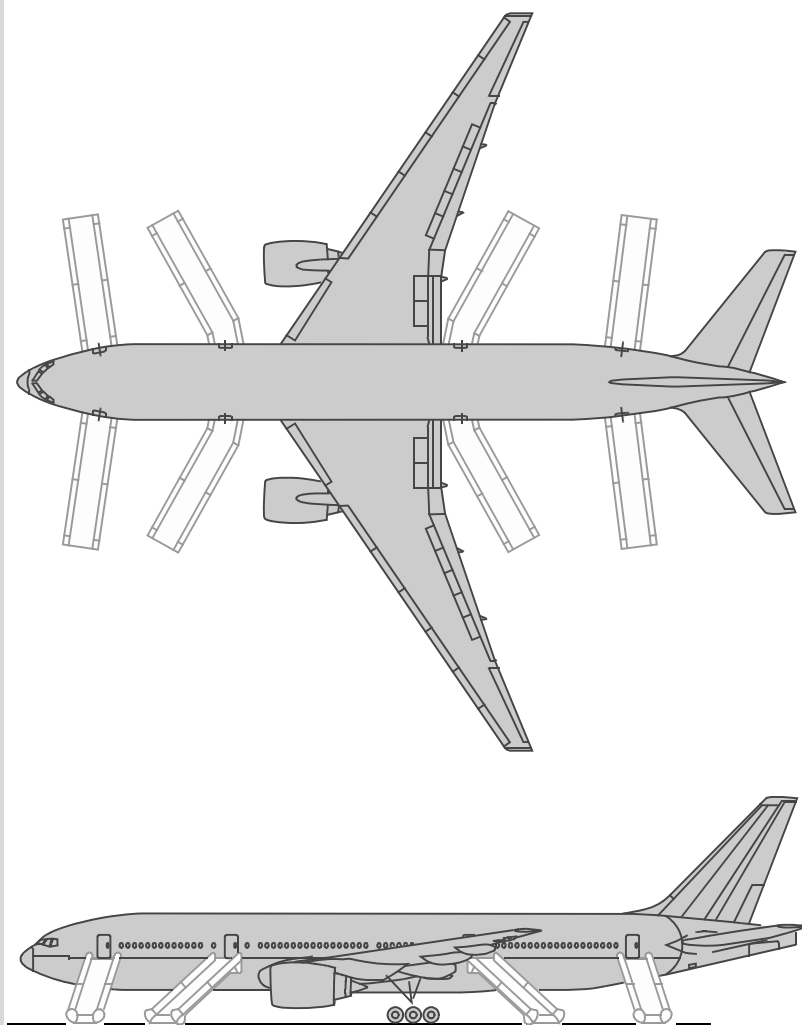




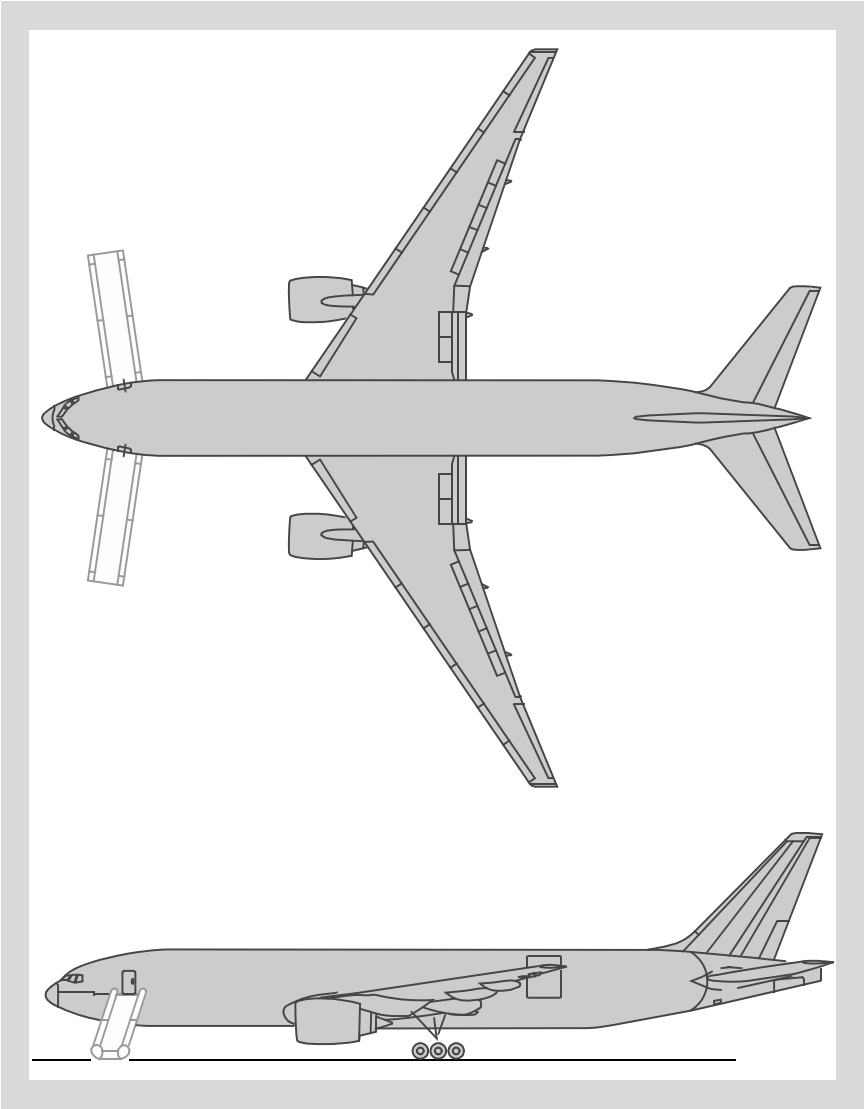
A life line is installed in the door 3 frame above each overwing exit. In a ditching emergency, the life line is attached to a hook on the wing leading edge, outboard of the engine. The life line is used as an attachment for the life raft mooring line and as a hand hold for passengers to walk out on the wing and into a life raft.

Evacuation Slide/Rafts

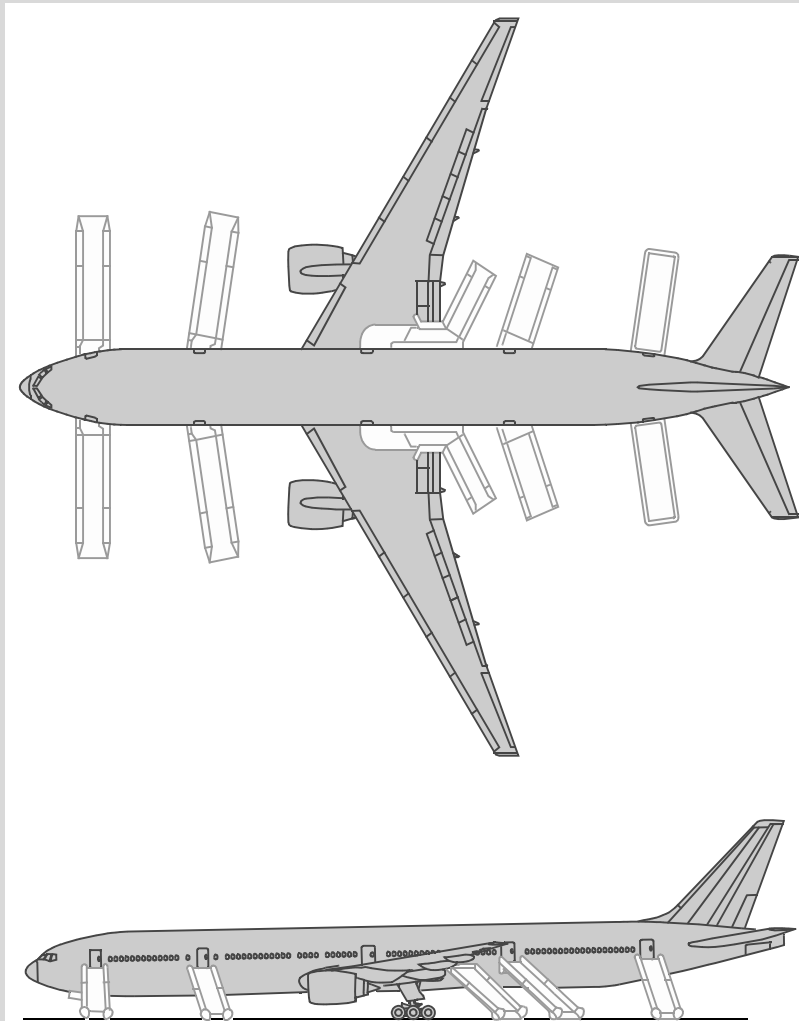
[777-200, 777-200ER, and 777-200LR]



[777F]



[777-300 and 777-300ER]



Cargo Doors

There are three lower cargo doors located on the right side of the airplane; one forward, one aft, and one bulk. The cargo doors all open upward. The forward and aft cargo doors open outward and the bulk cargo door opens inward.

Both forward and aft cargo doors are normally operated electrically from an exterior or interior fuselage-mounted control panel located with each door. A control panel light indicates cargo door latching. Forward and aft cargo door locking is accomplished manually. If necessary, the forward and aft cargo doors may be operated manually.

The bulk cargo door is manually opened and closed, and is counterbalanced for ease of operation.

Main Deck Cargo Door

[Freighter]

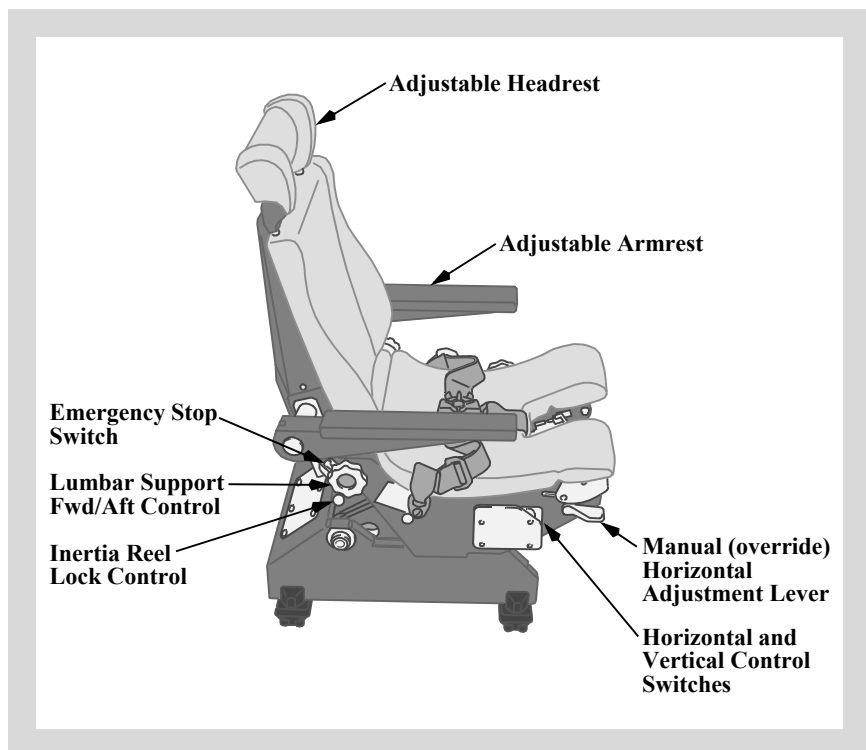
A main deck cargo door is located on the aft left side of the airplane. The door is operated from inside the airplane at either the forward or aft control panel. Each panel has lights that indicate the status of the door during opening and closing. Electric power to operate the door is supplied by the ground handling bus.

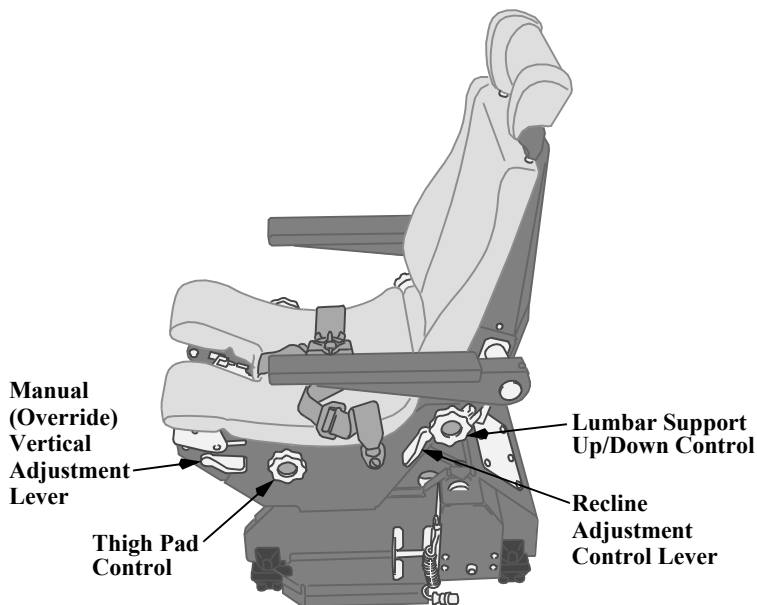
Flight Deck Seats

The flight deck has three seat types:

- pilot seats (captain and first officer)
- first observer seat
- second observer seat.

Pilot Seats





The pilot seats:

- recline
- adjust vertically
- adjust forward and aft
- adjust for thigh support
- adjust for the lumbar region of the back.

The seats also have:

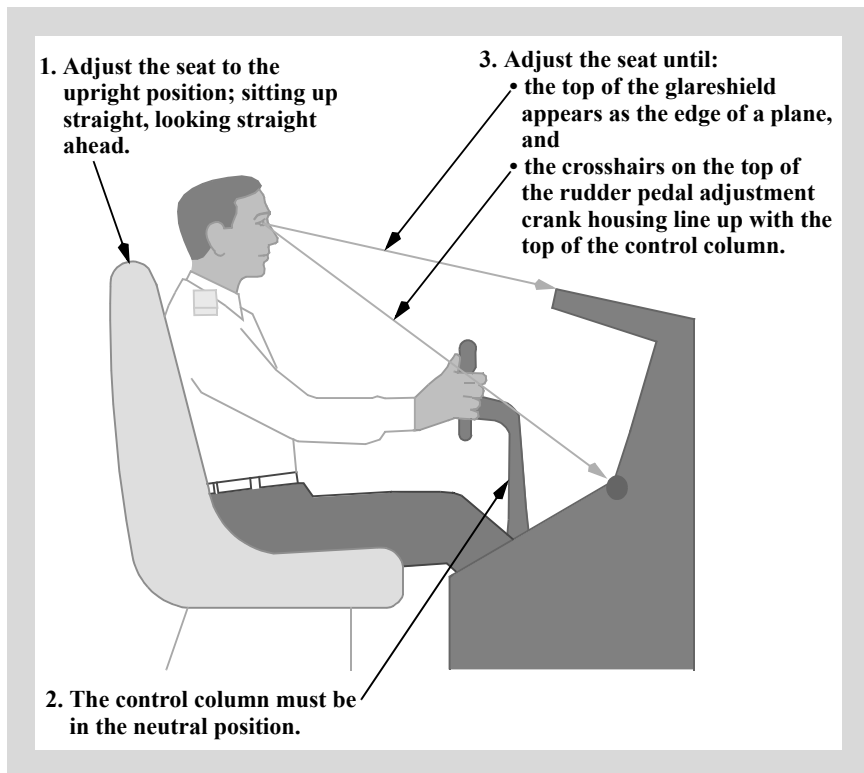
- adjustable armrests
- crotch straps
- inertial–reel shoulder harnesses with manual locks
- lap belts
- adjustable headrests.

The seats move outboard during the last two inches of aft travel. Electric and manual controls provide forward, aft, and vertical adjustment. Manual levers provide other adjustments.

Lumbar and thigh pad support can be adjusted using the adjustment hand wheels. Armrest pitch can be adjusted using the control knob under the armrest. The armrests can be stowed vertically for easier seat access. The headrest angle can be adjusted by moving the cushion to the right and turning it. There are eight positions.

Adjust the seat to obtain the optimum eye position as shown on the following illustration.

Pilot Seat Adjustment



Observer Seats

The first observer seat is pedestal-mounted. It adjusts manually in the vertical, forward and aft directions. The seat has:

- a folding arm rest on the left side
- lap belt
- adjustable headrest.
- crotch strap
- inertial-reel shoulder harness with manual locks

The second observer seat is not adjustable. The seat has:

- folding arm rests
- lap belt
- adjustable headrest.
- crotch strap
- shoulder harness with manual locks

Intentionally
Blank

**Airplane General, Emergency
Equipment, Doors, Windows
EICAS Messages****Chapter 1****Section 60****Airplane General, Emergency Equipment, Doors, Windows
EICAS Messages**

The following EICAS messages can be displayed.

Message	Level	Aural	Message Logic
CREW OXYGEN LOW	Advisory		Crew oxygen pressure is low.

[Option - large aft cargo door]

DOOR AFT CARGO	Caution	Beeper	Cargo door is not closed and latched and locked.
-------------------	---------	--------	--

[Option - small aft cargo door]

DOOR AFT CARGO	Advisory		Cargo door is not closed and latched and locked.
-------------------	----------	--	--

DOOR BULK CARGO	Advisory		Bulk cargo door is not closed and latched and locked.
DOOR E/E, FWD ACCESS	Advisory		Access door is not closed and latched and locked.

[777-200, 777-200ER, and 777-200LR]

DOOR ENTRY 1-4L, R	Advisory		Entry door is not closed and latched and locked.
-----------------------	----------	--	--

[777-300 and 777-300ER]

DOOR ENTRY 1-5L, R	Advisory		Entry door is not closed and latched and locked.
-----------------------	----------	--	--

[777F]

DOOR ENTRY 1L, 1R	Advisory		Entry door is not closed and latched and locked.
----------------------	----------	--	--

DOOR FWD CARGO	Caution	Beeper	Cargo door is not closed and latched and locked.
-------------------	---------	--------	--

Message	Level	Aural	Message Logic
---------	-------	-------	---------------

[777F]

DOOR MAIN DECK CARGO	Caution	Beeper	Main deck cargo door is not closed and latched and locked.
-------------------------	---------	--------	--

[777-300 and 777-300ER]

DOOR WING SLIDE L, R	Advisory		The door for the unpressurized wing slide compartment is not closed and locked.
-------------------------	----------	--	---

DOORS	Advisory		Two or more doors are not closed and latched and locked.
-------	----------	--	--

[Option]

ELT ON	Advisory		Emergency locator transmitter is on.
--------	----------	--	--------------------------------------

EMER LIGHTS	Advisory		Emergency lighting system has been manually activated or emergency lights switch is OFF.
-------------	----------	--	--

[Option]

PASS OXYGEN LOW	Advisory		Passenger oxygen pressure is low.
--------------------	----------	--	-----------------------------------

[Passenger]

PASS OXYGEN ON	Advisory		Passenger oxygen system is activated.
-------------------	----------	--	---------------------------------------

[Option]

SUPRNMRY OXYGEN LOW	Advisory		Supernumerary oxygen pressure is low.
------------------------	----------	--	---------------------------------------

[Freighter]

SUPRNMRY OXYGEN ON	Advisory		Supernumerary oxygen system is activated.
-----------------------	----------	--	---

WINDOW FLT DECK L, R	Advisory		Side window is not closed and latched.
-------------------------	----------	--	--

Message	Level	Aural	Message Logic
WINDOWS	Advisory		Left and right side windows are not closed and latched.

EICAS Memo Messages

Message	Level	Aural	Message Logic
---------	-------	-------	---------------

[Optional messages]

DOORS AUTO	Memo		All entry doors are in the armed mode.
DOORS AUTO/MANUAL	Memo		Some entry doors are in the armed mode and some are in the disarmed mode.
DOORS MANUAL	Memo		All entry doors are in the disarmed mode.

NO SMOKING ON	Memo		NO SMOKING switch is in the on position.
PASS SIGNS ON	Memo		The NO SMOKING and SEAT BELTS switches are in the on position.
SEATBELTS ON	Memo		The SEAT BELTS switch is in the on position.

[Option]

THERAPEUTIC OXY ON	Memo		Therapeutic oxygen is on.
-----------------------	------	--	---------------------------

Intentionally
Blank

Air Systems**Chapter 2****Table of Contents****Section 0**

Controls and Indicators	2.10
Air Conditioning System	2.10.1
Air Conditioning Panel	2.10.1
Cabin Temperature Control	2.10.6
Shoulder and Foot Heaters	2.10.7
Cargo Temperature Control	2.10.8
Lower Cargo Temperature Control	2.10.10
Pressurization System	2.10.12
Pressurization Panel	2.10.12
Duct Pressure and Pressurization System Indications	2.10.13
Bleed Air System	2.10.15
Air Synoptic Display	2.10.17
Air Conditioning System Description	2.20
Introduction	2.20.1
Air Conditioning Packs	2.20.2
Pack Ground Operation	2.20.2
Pack Non-Normal Operation	2.20.2
Standby Cooling Mode	2.20.2
Air Distribution	2.20.3
Alternate Ventilation System	2.20.4
Temperature Control	2.20.4
Crew Rest Area Temperature Control	2.20.6
Temperature Control With Loss of Trim Air	2.20.6
Operation With Complete Loss of Zone Temperature Control	2.20.7
Shoulder and Foot Heaters	2.20.7
Flight Deck Humidification System	2.20.8
Gasper System	2.20.8
Cargo Temperature Control System	2.20.8
Cargo Heat System	2.20.8
Forward Cargo Compartment Air Conditioning System	2.20.9

Lower Cargo Air Conditioning System	2.20.9
Air Conditioning System Schematic	2.20.11
Equipment Cooling, Equipment Ventilation, Lavatory and Galley Ventilation	2.20.14
Pressurization System Description	2.30
Introduction	2.30.1
Pressurization System Automatic Operation	2.30.1
Cabin Altitude Controller Automatic Operation With Loss of Landing Altitude	2.30.2
Pressurization System Manual Operation	2.30.2
Bleed Air System Description	2.40
Introduction	2.40.1
Engine Bleed Air Supply	2.40.1
APU Bleed Air Supply	2.40.1
APU to Pack Takeoff	2.40.1
Ground Bleed Air Supply	2.40.3
Bleed Air Duct System	2.40.3
Duct Leak and Overheat Detection System	2.40.3
Bleed Air System Schematic	2.40.4
Air Systems EICAS Messages	2.50
Air Systems EICAS Alert Messages	2.50.1
EICAS Memo Messages	2.50.3

Air Systems
Controls and Indicators

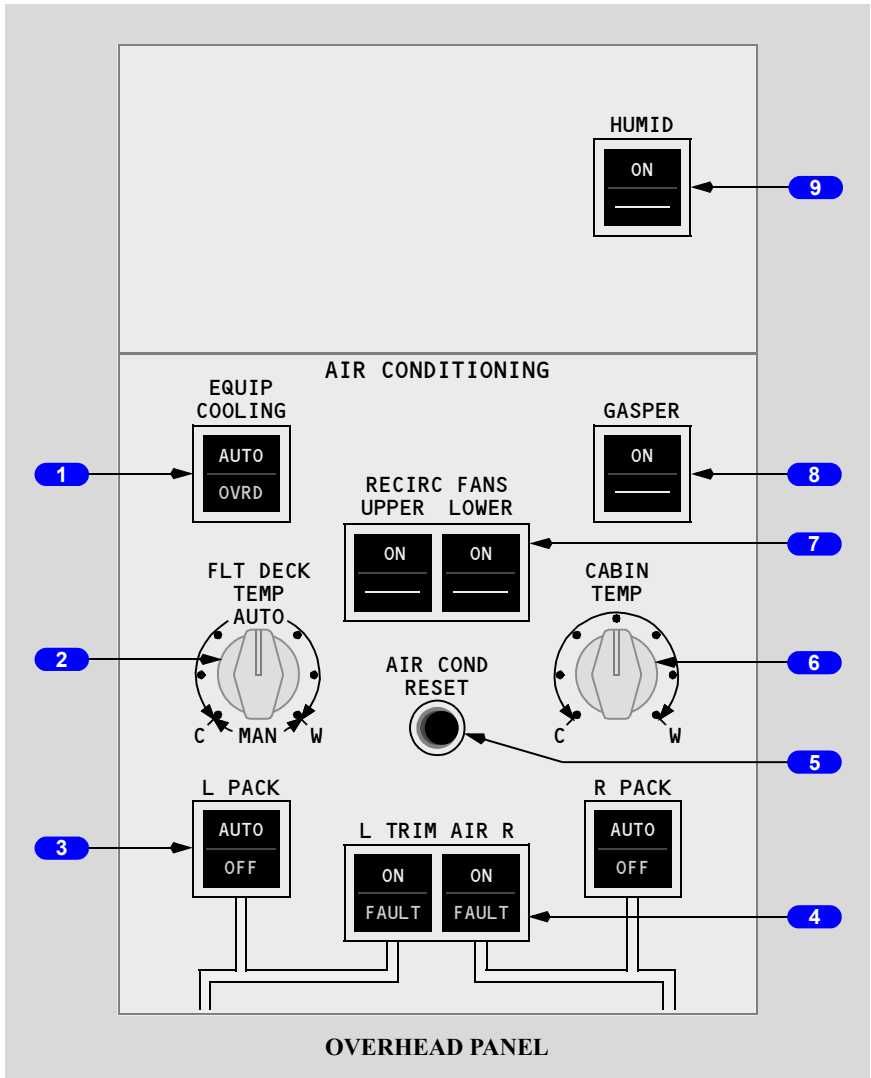
Chapter 2
Section 10

Air Conditioning System

Air Conditioning Panel

[Passenger]

[Options - Humidifier, Gasper]



1 Equipment Cooling (EQUIP COOLING) Switch

AUTO – equipment cooling mode is controlled automatically.

Off (AUTO not visible) –

- both equipment cooling supply fans are not operating
- the override valve is open
- the forward cargo heat valve is closed
- the OVRD light is illuminated

OVRD (override) illuminated (amber) – equipment cooling override valve is open.

2 Flight Deck Temperature (FLT DECK TEMP) Control

AUTO –

- provides automatic temperature control for the flight deck

[Option – °F]

- turning the control toward C or W sets the desired temperature between 65 degrees F and 85 degrees F. Mid position (12 o'clock) sets approximately 75 degrees F.

[Option – °C]

- turning the control toward C or W sets the desired temperature between 18 degrees C and 29 degrees C. Mid position (12 o'clock) sets approximately 24 degrees C.

MAN (manual) –

- provides manual control of the flight deck trim air modulating valve
- turning the control from the MAN position to the C detent drives the flight deck trim air modulating valve toward closed to provide cooler air
- turning the control from the MAN position to the W detent drives the flight deck trim air modulating valve toward open to provide warmer air.

3 PACK Switches

AUTO – the pack is controlled automatically.

Off (AUTO not visible) – the pack flow control valve is commanded closed.

OFF illuminated (amber) – the pack flow control valve is closed. The pack flow control valve is commanded closed and the OFF light is illuminated when:

- the pack valve is failed closed, or
- a pack or compressor outlet high temperature has occurred, or
- bleed air pressure is inadequate, or
- the R PACK valve is closed during APU to Pack Takeoff procedure, or
- the PACK switch is pushed off.

4 TRIM AIR Switches

ON – the trim air valve is commanded open.

Off (ON not visible) –

- the trim air valve is commanded closed, and
- FAULT illuminates.

FAULT illuminated (amber) –

- the trim air valve is failed closed
- the trim air valve is commanded closed because of a zone supply duct overheat, or
- the TRIM AIR switch is selected off.

5 Air Conditioning Reset (AIR COND RESET) Switch

Push –

- resets any closed pack flow control valves or trim air valves held closed due to overheat, control failure, or valve failure
- attempts to reset a failed recirculation fan
- resets fault protection.

6 Cabin Temperature (CABIN TEMP) Control

Provides automatic passenger cabin temperature control.

[Option – °F]

Turning the control toward C or W sets the passenger cabin master reference temperature between 65 degrees F and 85 degrees F.

[Option – °C]

Turning the control toward C or W sets the passenger cabin master reference temperature between 18 degrees C and 29 degrees C.

7 Recirculation Fans (RECIRC FANS) Switches

ON – provides automatic operation of the associated recirculation fans.

Off (ON not visible) – the selected recirculation fans do not operate.

8 GASPER Switch

ON – the gasper fan operates.

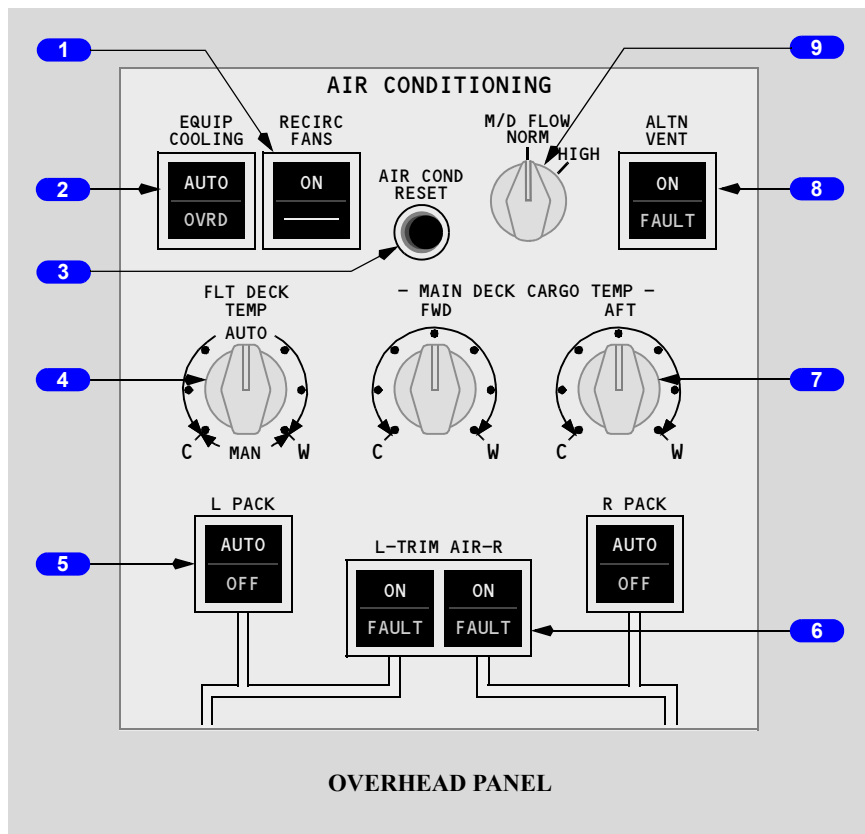
Off (ON not visible) – the gasper fan does not operate.

9 Humidification (HUMID) Switch

ON – humidification system operates automatically.

Off (ON not visible) – humidifier does not operate.

[Freighter]



1 Recirculation Fans (RECIRC FANS) Switch

ON – provides automatic operation of the recirculation fans.

Off (ON not visible) – the recirculation fans do not operate.

2 Equipment Cooling (EQUIP COOLING) Switch

AUTO – equipment cooling mode is controlled automatically.

Off (AUTO not visible) –

- both equipment cooling supply fans are not operating
- the override valve is open
- the forward cargo heat valve is closed
- nitrogen generation system (NGS) is shut down

OVRD (override) illuminated (amber) – equipment cooling override valve is open.

3 Air Conditioning Reset (AIR COND RESET) Switch

Push –

- attempts to reset any closed pack flow control valves or trim air valves latched closed due to overheat, control failure, or valve failure
- attempts to reset a failed recirculation fan
- resets fault protection

4 Flight Deck Temperature (FLT DECK TEMP) Selectors

AUTO –

- flight deck and supernumerary zone temperatures controlled automatically
- range C to W sets temperature between 65°F and 85°F (18°C and 29°C). Mid position (12 o'clock) sets approximately 75°F (24°C)

MAN (manual) (spring loaded to 6 o'clock position) – flight deck and supernumerary trim air valves controlled manually.

C (cool) – valves move towards closed to provide cooler air.

W (warm) – valves move towards open to provide warmer air.

5 PACK Switches

AUTO – the pack is controlled automatically.

Off (AUTO not visible) – the pack flow control valve is commanded closed.

OFF illuminated (amber) – the pack flow control valve is closed. The pack flow control valve is commanded closed and the OFF light is illuminated when:

- the pack valve is failed closed, or
- a pack or compressor outlet high temperature has occurred, or
- bleed air pressure is inadequate, or
- the R PACK valve is closed during APU to Pack Takeoff procedure, or
- the PACK switch is pushed off.

6 TRIM AIR Switches

ON – the trim air valve is commanded open.

Off (ON not visible) – the trim air valve is commanded closed.

FAULT illuminated (amber) –

- the trim air valve is failed closed
- the trim air valve is commanded closed because of a zone supply duct overheat, or
- the TRIM AIR switch is off.

7 Main Deck Cargo Temperature (MAIN DECK CARGO TEMP) Selectors

Main deck cargo compartment temperatures controlled automatically.

Range C to W sets temperature between 40°F and 80°F (4°C and 27°C). Mid position (12 o'clock) sets approximately 60°F (16°C).

8 Alternate Ventilation (ALTN VENT) Switch

ON –

- alternate ventilation system fan operates and alternate ventilation system shutoff valves open
- lavatory galley vent fans shut down and lavatory galley shutoff valve closed.

Off (ON not visible) – Alternate ventilation system does not operate. Alternate ventilation system shutoff valves closed.

FAULT illuminated (amber) – Alternate ventilation system failure is occurring.

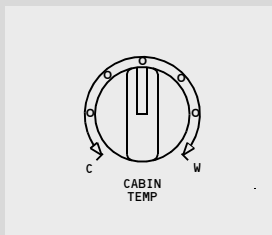
9 Main Deck Air Flow Rate (M/D FLOW) Selector

NORM – pack airflow is controlled automatically.

HIGH – all operating packs configured to high flow.

Cabin Temperature Control

[Freighter]

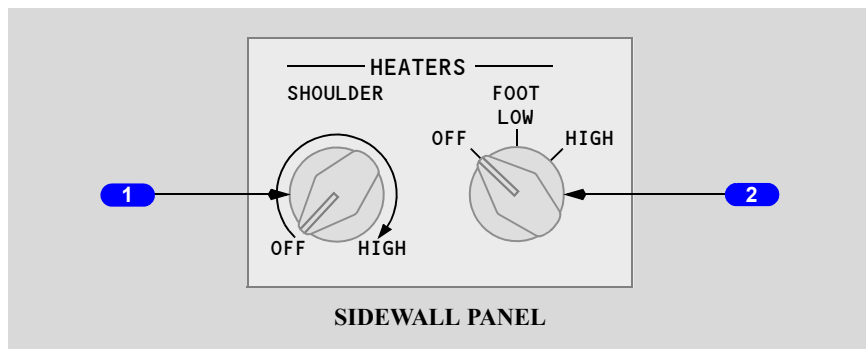


SUPERNUMERARY CONTROL AND DISPLAY PANEL

1 Cabin Temperature (CABIN TEMP) Selector

Provides automatic temperature control for the supernumerary area.

Range C to W sets temperature between 65°F and 85°F (18°C and 29°C). Mid position (12 o'clock) sets approximately 75°F (24°C)

Shoulder and Foot Heaters**1 SHOULDER HEATER Control**

OFF – the electric heater in shoulder level conditioned air supply duct is not operating.

Set – the electric heater adds heat to the condition air supplied at shoulder level at temperature settings up to HIGH.

2 FOOT HEATER Selector

OFF – under-floor electric heater off.

LOW – under-floor electric heater operates at low heating rate.

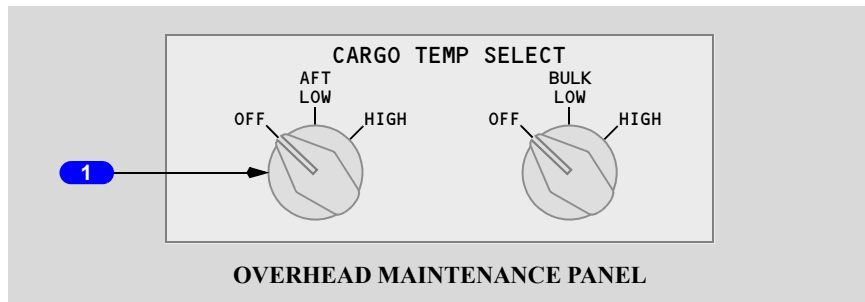
HIGH – under-floor electric heater operates at high heating rate.

Cargo Temperature Control

[Passenger]

[Option - without Fwd Cargo A/C]

Aft and Bulk Cargo Temperature Control



1 CARGO TEMPERATURE Selectors

OFF – shuts off bleed air to the compartment.

[Option – °C]

LOW – the compartment temperature is maintained between 4 and 10 degrees C.

[Option – °F]

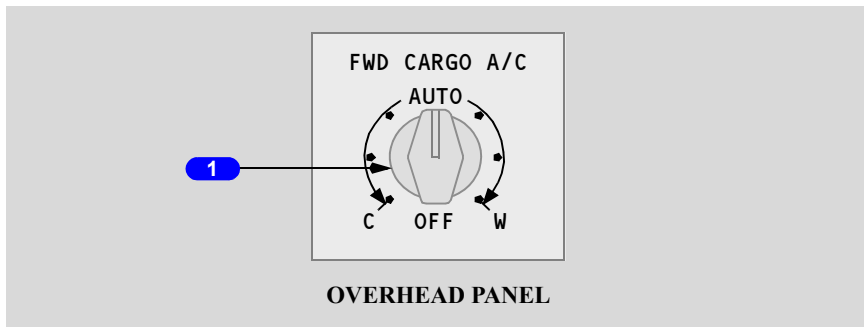
LOW – the compartment temperature is maintained between 40 and 50 degrees F.

[Option – °C]

HIGH – the compartment temperature is maintained between 18 and 24 degrees C. For the bulk compartment only – the bulk compartment ventilation fan operates continuously.

[Option – °F]

HIGH – the compartment temperature is maintained between 65 and 75 degrees F. For the bulk compartment only, the bulk compartment ventilation fan operates continuously.

Forward Cargo Air Conditioning Control**[Passenger - Option]****1 Forward Cargo Air Conditioning (FWD CARGO A/C) Selector**

AUTO –

- provides automatic temperature control for the forward cargo compartment
- disables the forward cargo compartment heating system

[Option – °F]

- turning the control toward C or W sets the desired temperature between 40 degrees F and 80 degrees F. Mid position (12 o'clock) sets approximately 60 degrees F.

[Option – °C]

- turning the control toward C or W sets the desired temperature between 4 degrees C and 27 degrees C. Mid position (12 o'clock) sets approximately 16 degrees C.

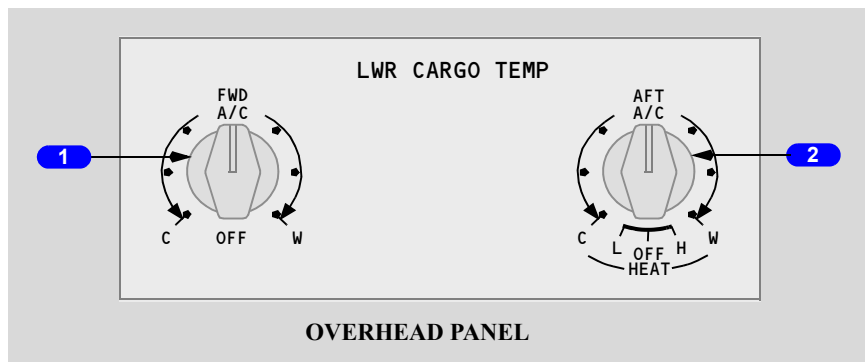
OFF – the forward cargo compartment heating system operates.

Lower Cargo Temperature Control

[Freighter]

Lower Cargo Temperature Panel

[Option – Freighter - Lower Aft Cargo A/C]



1 Lower Cargo Temperature Forward (LWR CARGO TEMP FWD) Selector

A/C –

- lower forward cargo compartment conditioned air temperatures controlled automatically
- range C to W sets temperature between 40°F and 80°F (4°C and 27°C). Mid position (12 o'clock) sets approximately 60°F (16°C).

OFF – shuts off lower forward cargo air conditioning

2 Lower Cargo Temperature (LWR CARGO TEMP AFT) Selector

A/C –

- lower aft cargo compartment conditioned air temperatures controlled automatically
- range C to W sets temperature between 40°F and 80°F (4°C and 27°C). Mid position (12 o'clock) sets approximately 60°F (16°C).
- shuts off aft cargo compartment bleed air heating system

Low (L) –

- shuts off lower aft cargo compartment air conditioning
- bleed air heating system maintains compartment temperature between 40°F and 50°F (4°C and 10°C)

OFF –

- shuts off lower aft cargo compartment air conditioning
- shuts off bleed air heating system to the compartment

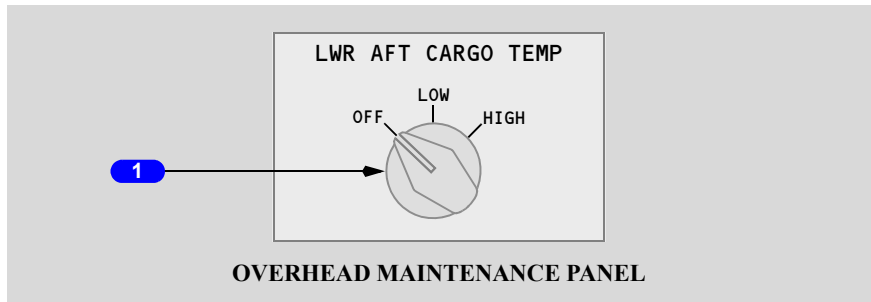
High (H) –

- shuts off lower aft cargo air conditioning
- bleed air heating system maintains compartment temperature between 65°F and 75°F (18°C and 24°C)

Lower Cargo Temperature Panels

[Option –Freighter - without Lower Aft Cargo A/C]

Lower Aft Cargo Temperature Panel



1 Lower Aft Cargo Temperature (LWR AFT CARGO TEMP) Selector

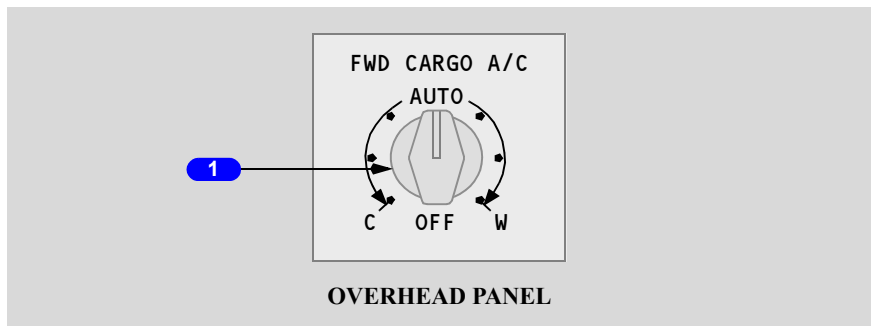
OFF – shuts off bleed air heating to the compartment.

LOW – bleed air heating system maintains compartment temperature between 40°F and 50°F (4°C and 10°C).

HIGH – bleed air heating system maintains compartment temperature between 65°F and 75°F (18°C and 24°C).

Lower Forward Cargo Air Conditioning Panel

[Option – Freighter - without Lower Aft Cargo A/C]



1 Lower Forward Cargo Air Conditioning (FWD CARGO A/C) Selector

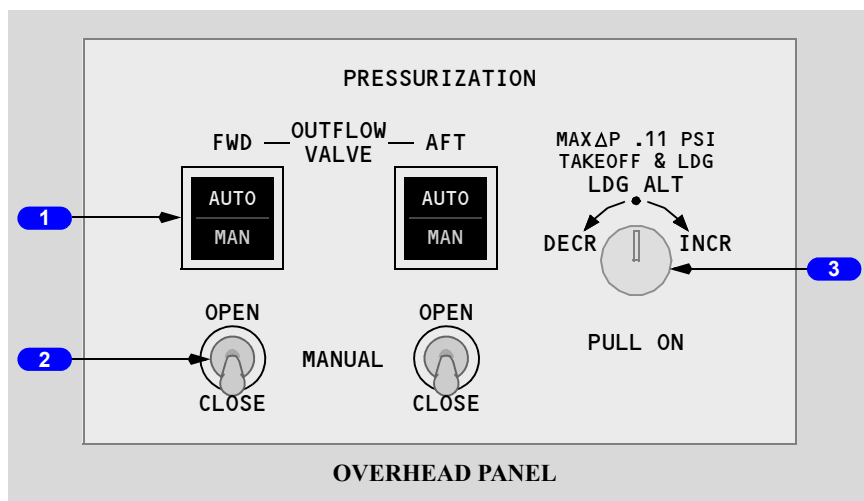
AUTO –

- lower forward cargo compartment conditioned air temperatures controlled automatically
- range C to W sets temperature between 40°F and 80°F (4°C and 27°C). Mid position (12 o'clock) sets approximately 60°F (16°C).

OFF – shuts off lower forward cargo compartment air conditioning

Pressurization System

Pressurization Panel



1 OUTFLOW VALVE Switches

AUTO – outflow valve controlled automatically.

MAN (manual) illuminated (amber) –

- outflow valve is controlled manually
- bypasses automatic outflow valve control and cabin altitude limiter
- AUTO extinguished

2 OUTFLOW VALVE MANUAL Switches

OPEN – moves the outflow valve toward open.

CLOSE – moves the outflow valve toward closed.

3 Landing Altitude (LDG ALT) Selector

Pull ON, then rotate –

- sets landing altitude manually
- landing altitude followed by MAN displayed on EICAS
- landing altitude changes in 100 foot increments at first detent, 500 foot increments at second detent

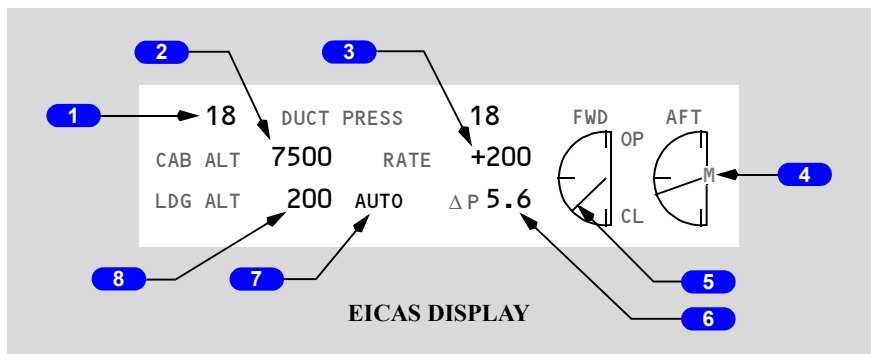
Push –

- landing altitude set automatically from FMS – Refer to Chapter 11, Flight Management Navigation – Approach
- landing altitude followed by AUTO displayed on primary EICAS

Duct Pressure and Pressurization System Indications

Pressurization system indications are displayed automatically when:

- landing altitude MAN
- either OUTFLOW VALVE switch in MAN
- cabin altitude is above normal range (amber)
- cabin differential pressure is above normal range (amber)
- cabin differential pressure is excessive (red)
- duct pressure is below normal range (amber) with the respective engine running
- AIR synoptic selected on any MFD
- the following EICAS messages are displayed:
 - CABIN ALTITUDE
 - CABIN ALTITUDE AUTO
 - LANDING ALTITUDE
 - OUTFLOW VALVE AFT
 - OUTFLOW VALVE FWD.

**1 Duct Pressures**

White – normal range.

Amber – below normal range.

2 Cabin Altitude

White – normal range.

Amber – above normal range.

Red – excessive cabin altitude.

3 Cabin Altitude Rate

+ (plus) – rate of climb.

– (minus) – rate of descent.

4 Outflow Valve Control Source

M (manual) (amber) – manual control.

Blank – automatic control.

5 Outflow Valves Position

OP – open.

CL – closed.

6 Cabin Differential Pressure

White – normal range.

Amber – above normal range.

Red – excessive cabin differential pressure.

7 Landing Altitude Selection

AUTO (white) – altitude set automatically from FMC.

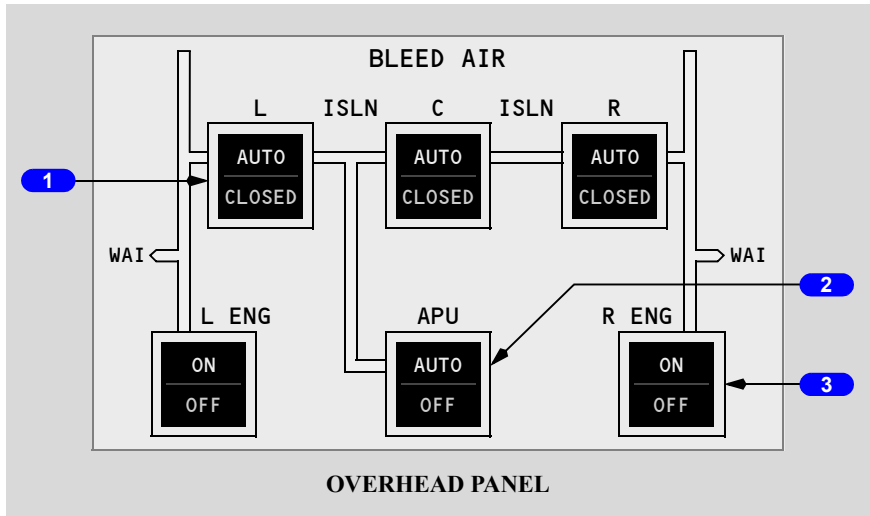
MAN (amber) – altitude set by LANDING ALTITUDE selector.

8 Landing Altitude

Landing altitude supplied by the FMC or manually selected using the LANDING ALTITUDE selector.

Blank – display is blank without valid FMC landing altitude.

Bleed Air System



1 Bleed Isolation (ISLN) Switches

AUTO – the bleed isolation valve is controlled automatically

Off (AUTO not visible) – respective valve commanded closed.

CLOSED illuminated (amber) –

- the valve is closed due to a duct leak or bleed loss
- the valve fails closed, or
- the respective ISLN switch is off.

2 APU Bleed Switch

AUTO – the APU bleed air valve opens by system logic when bleed air pressure is available.

Off (AUTO not visible) – the valve is commanded closed.

OFF illuminated (amber) – the APU bleed air valve is closed.

- automatically due to a duct leak
- due to the valve failing closed
- when the APU fire switch is pulled out.

3 Engine (ENG) Bleed Switches

ON – the engine bleed valve opens when engine bleed air is available.

Off (ON not visible) – valve is manually commanded closed.

OFF illuminated (amber) – the engine bleed valve is closed. The engine bleed valve is commanded closed and the OFF light is illuminated when:

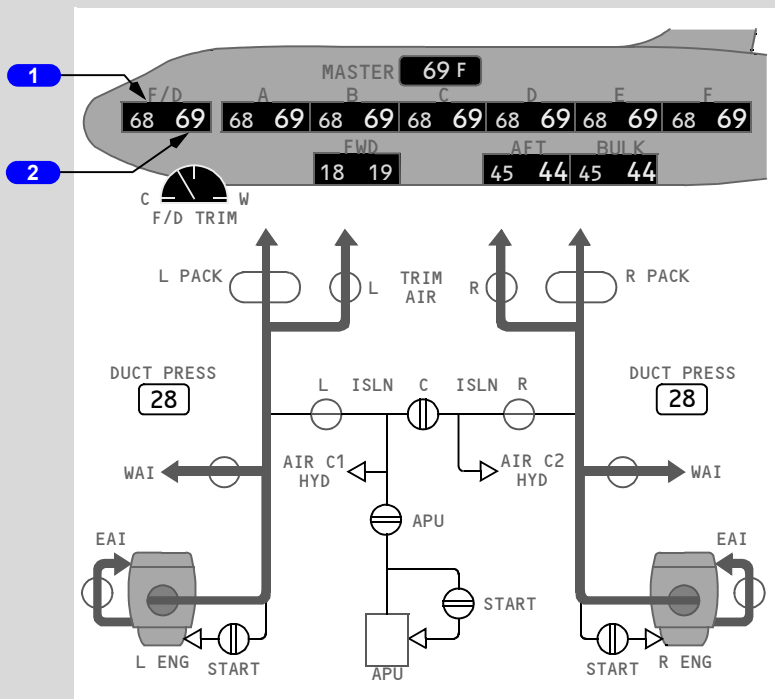
- the engine is not running, or
- a bleed air overheat occurs, overpressure, or bleed control system failure has occurred, or
- the engine bleed valve is failed closed, or
- the ENG fire switch is pulled out, or
- the L ENG bleed valve is closed during APU to Pack Takeoff procedure, or
- the engine bleed switch is pushed off.

Air Synoptic Display

The air systems synoptic is displayed by pushing the AIR synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

[Passenger]

[Options – °F, Fwd Cargo A/C]



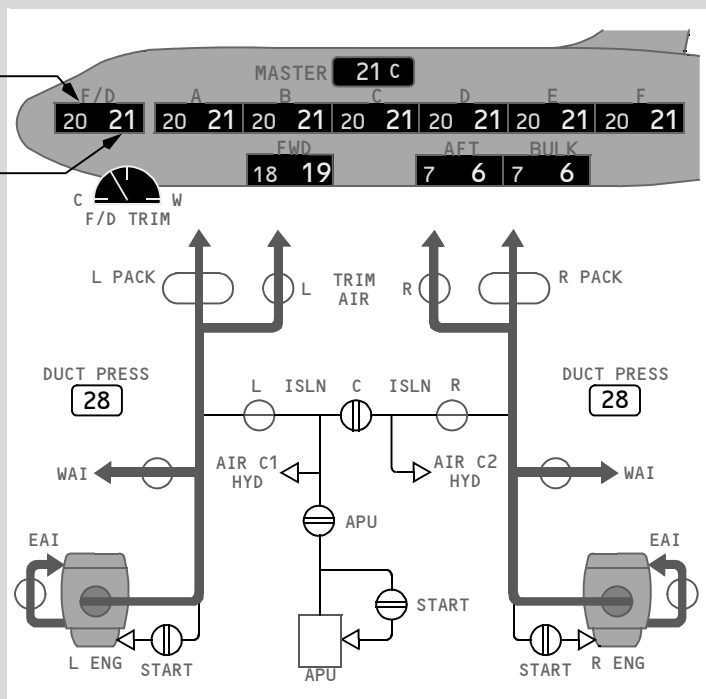
F/D - flight deck
ISLN - isolation valves

WAI - wing anti-ice valve
EAI - engine anti-ice valve

MULTIFUNCTION DISPLAY

[Passenger]

[Options – °C, Fwd Cargo A/C]



F/D - flight deck
ISLN - isolation valves

WAI - wing anti-ice valve
EAI - engine anti-ice valve

MULTIFUNCTION DISPLAY

1 Selected Temperatures (magenta)

Selected by the FLT DECK TEMP, FWD CARGO A/C, and the CABIN TEMP controls.

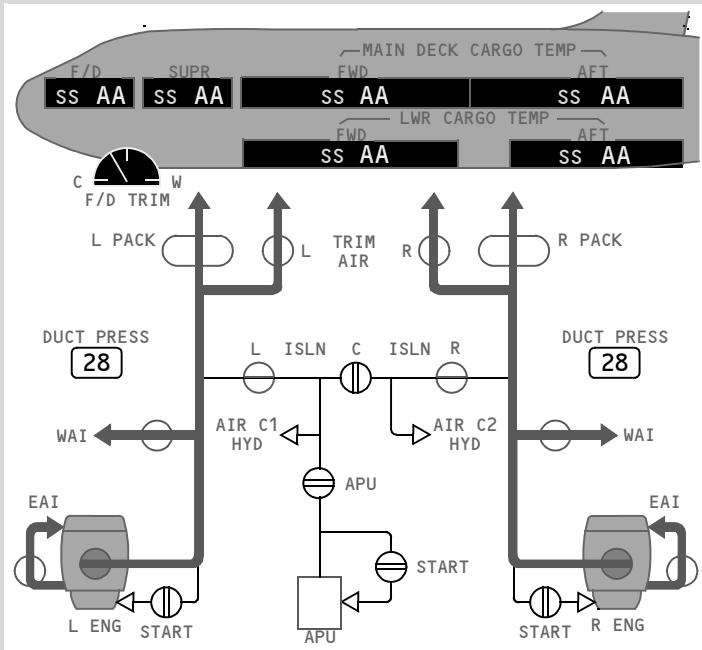
2 Actual Temperatures (white)

Actual temperature sensed on the flight deck, forward cargo compartment, or the passenger zone.

777 Operations Manual

[Freighter]

[Option – Lower Aft Cargo A/C]



F/D - flight deck

SUPER - Supernumerary

AA (white) - actual temperature

SS (magenta) - selected temperature

EAI - engine anti-ice valve

ISLN - isolation valves

WAI - wing anti-ice valve

MULTIFUNCTION DISPLAY

F/D, SUPER, MAIN DECK, LWR CARGO - selected temperature not displayed when respective compartment conditioned air is OFF or inoperative.

Intentionally
Blank

Air Systems**Chapter 2****Air Conditioning System Description****Section 20****Introduction**

The air conditioning system supplies conditioned bleed air and recirculated cabin air at a controlled temperature throughout the airplane.

The system supplies conditioned air to the flight deck shoulder heaters.

[Passenger]

The system supplies ventilation for the passenger cabin:

- lavatories
- galleys

[Option – Gasper]

- individual passenger seat gaspers

[Passenger]**[Option – Crew Rest Compartments]**

- lower crew rest compartment
- overhead crew rest compartments
- flight deck crew rest compartment

[Freighter]

The system supplies ventilation for the crew rest, lavatory, and galley.

Pack control, zone temperature control, cabin air recirculation, fault detection, and overheat protection are all automatic. Backup system control modes operate automatically in the event of system failures.

[Passenger]**[Option – Forward Cargo A/C]**

The airplane is divided into eight temperature zones: the flight deck, six passenger cabin zones, and the forward cargo compartment.

[Freighter]**[Option – Lower Aft Cargo A/C]**

The airplane is divided into six temperature zones: the flight deck, supernumerary cabin, forward and aft main deck cargo zones, and the forward and aft lower cargo compartments.

Air Conditioning Packs

Two identical air conditioning packs cool bleed air from the engines, APU, or high pressure air from a ground source. Bleed air is precooled before entering the pack. Each pack is controlled by two redundant channels in one of two separate controllers. If one channel fails in a controller, control of the respective pack is continued automatically by the redundant channel in that controller.

Pack Ground Operation

Both air conditioning packs are normally selected to AUTO for ground operations. Fuel consumption is about the same for single pack and two pack operation, and single pack operation causes higher flight line noise levels.

A ground source of conditioned air may be used to supply conditioned air directly to the cabin distribution system, eliminating the need for pack operation.

Pack Non-Normal Operation

Pack control, fault detection, and overheat protection are all automatic. If an overheat or other significant pack fault is detected, the pack shuts down automatically. An attempt to restore pack operation may be made by pressing the AIR COND RESET switch.

Standby Cooling Mode

For certain internal malfunctions, pack control automatically uses standby cooling mode as a backup to normal mode. In standby cooling mode, the EICAS advisory message PACK MODE (L, R) is displayed, and STBY COOLING is displayed in amber on the AIR synoptic.

If one pack is in standby cooling and the other pack is operating normally, the pack in standby cooling mode shuts down at lower altitudes and higher outside air temperatures when ambient conditions do not permit standby cooling. The pack restarts automatically when altitude and outside air temperatures are suitable for standby cooling.

If both packs are in standby cooling mode, or if one pack is inoperative and the other pack is in standby cooling mode, the packs or pack operates continuously to maintain cabin pressurization, regardless of altitude or outside air temperature.

In standby cooling mode, pack cooling capacity may be less than in normal mode and may result in warm flight deck or cabin temperatures at lower altitudes.

Air Distribution

[Passenger]

The flight deck receives 100% fresh conditioned air from the left pack. The flight deck is maintained at a slightly higher pressure than the passenger cabin to prevent smoke and objectionable odors from entering the flight deck.

[Freighter]

The flight deck and supernumerary cabin receive 100% fresh conditioned air from the left pack. To prevent smoke and objectionable odors from entering the occupied compartments, the flight deck and supernumerary cabin are maintained at a slightly higher pressure than the main deck cargo and lower cargo compartments.

[Passenger]

Recirculation fans assist the packs to maintain a constant ventilation rate through the cabin. The fans draw cabin air through filters, then reintroduce the air into the conditioned air distribution system.

[Freighter]

Recirculation fans assist the packs to maintain a constant ventilation rate through the cargo compartments. The fans draw cabin air through filters, then reintroduce the air into the cargo conditioned air distribution system.

[Passenger]

Air exhausted from the passenger cabin flows into the upper recirculation system or to the lower deck, where it is either exhausted overboard through outflow valves or drawn into the lower recirculation system. Air from the recirculation fans is mixed with pack air before entering the distribution ducts.

[Freighter]

Air exhausted from the main deck cargo compartment flows into the lower deck, where it is either exhausted overboard through outflow valves or drawn into the recirculation system. Air from the recirculation fans is mixed with pack air before entering the cargo compartment distribution ducts.

[Freighter]

When the RECIRC FANS switch is OFF, the packs operate at full flow, the cabin air exchange rate is increased, and fuel consumption increases 0.7%.

Alternate Ventilation System

[Freighter]

The alternate ventilation system provides air flow into the flight deck and supernumerary cabin when both air conditioning packs are inoperative. If the airplane is not pressurized normally and the ALTN VENT switch is ON, air is drawn from the aft outflow valve and provided to the flight deck and supernumerary cabin. When the airplane is pressurized normally and the ALTN VENT switch is ON, there is no air flow through the alternate ventilation system.

Temperature Control

Zone temperatures are controlled by the cabin air conditioning and temperature control system (CACTCS). Hot trim air from the bleed air system is added through trim air valves in the conditioned air supply ducts. The CACTCS modulates the zone trim air valves to achieve the target temperature of the conditioned air in each zone.

[Passenger]

[Option – Fwd Cargo A/C]

Trim air from the left engine bleed is added to conditioned air ducts for the flight deck, three passenger cabin zones, and the aft cargo compartment. Trim air from the right engine is added to the conditioned air ducts for the other three passenger cabin zones and the forward cargo and E & E compartments.

[Freighter]

[Option – Lower Aft Cargo A/C]

Trim air from the left engine bleed is added to conditioned air ducts for the flight deck, supernumerary cabin, forward main deck cargo, and lower aft cargo compartments. Trim air from the right engine is added to the conditioned air ducts for the aft main deck cargo, lower forward cargo, and E & E compartments.

[Passenger]

[Option – °F]

The CABIN TEMP selector sets a master reference temperature between 65 and 85 degrees F. The master reference temperature is increased or decreased automatically or manually to set target temperatures for each temperature zone.

[Passenger]

[Option – °C]

The CABIN TEMP selector sets a master reference temperature between 18 and 29 degrees C. The master reference temperature is increased or decreased automatically or manually to set target temperatures for each temperature zone.

[Passenger]

For passenger comfort, the CACTCS compensates for temperature changes as cabin air humidity and passenger activity decrease during the flight. The target temperatures increase automatically slowly during the early part of cruise flight so the flight crew does not have to manually increase the master temperature. Target temperatures decrease slowly during descent until all automatically added corrections are removed.

[Passenger]
[Option – °F]

The target temperatures of each passenger cabin temperature zone may be further modified plus or minus 10 degrees F, within the range of 65 and 85 degrees F, using the cabin management system.

[Passenger]
[Option – °C]

The target temperatures of each passenger cabin temperature zone may be further modified plus or minus 6 degrees C, within the range of 18 to 29 degrees C, using the cabin management system.

[Passenger]
[Option – °F]

The FLT DECK TEMP selector sets the flight deck temperature to between 65 and 85 degrees F. Flight deck temperature is controlled manually by setting the selector to MAN.

[Passenger]
[Option – °C]

The FLT DECK TEMP selector sets the flight deck temperature to between 18 and 29 degrees C. Flight deck temperature is controlled manually by setting the selector to MAN.

[Freighter]

The FLT DECK TEMP selector sets a temperature for the flight deck and the supernumerary cabin zones to between 65°F and 85°F (18°C and 29°C). The supernumerary cabin temperature may be modified plus or minus 10°F (6°C), within the range of 65°F and 85°F (18°C and 29°C), using the CABIN TEMP selector on the supernumerary control and display panel. Flight deck and supernumerary cabin temperature is controlled manually by setting the selector to MAN.

The temperature zone requiring the coolest temperature controls the pack outlet temperature.

[Passenger]
[Option – °F]

If the flight deck or cabin temperature selector setting is unavailable to the pack temperature controller, the pack outlet temperature is regulated to achieve either the last temperature set or an average cabin temperature of 75 degrees F.

[Passenger]]
[Option – °C]

If the flight deck or cabin temperature selector setting is unavailable to the pack temperature controller, the pack outlet temperature is regulated to achieve either the last temperature set or an average cabin temperature of 24 degrees C.

[Freighter]

If the FLT DECK TEMP or MAIN DECK CARGO TEMP selector setting is unavailable to the pack temperature controller, the pack outlet temperature is regulated to achieve either the last temperature set or an average flight deck temperature of 75°F (24°C).

Crew Rest Area Temperature Control

[Option – Crew Rest Compartments]

Crew rest area temperature can be controlled manually by the heater controls in the compartment.

Temperature Control With Loss of Trim Air

[Passenger]
[Option – °F]

If the left or right trim air system is off, the CACTCS attempts to maintain all zones at the average target temperature. Flight deck temperature will be maintained between 65 and 85 degrees F.

[Passenger]
[Option – °C]

If the left or right trim air system is off, the CACTCS attempts to maintain all zones at the average target temperature. Flight deck temperature will be maintained between 18 and 29 degrees C.

[Freighter]

If the left or right trim air system is off, the CACTCS attempts to maintain all zones at the average selected temperature. Flight deck temperature will be maintained between 65°F and 85°F (18°C and 29°C).

[Passenger]

The flight deck may become uncomfortably warm or cool. Setting the CABIN TEMP selector to a cooler or warmer master temperature may achieve a cooler or warmer flight deck temperature.

[Freighter]

The flight deck may become uncomfortably warm or cool. Setting the FWD or AFT MAIN DECK CARGO TEMP selector to a cooler or warmer temperature may achieve a cooler or warmer flight deck temperature.

Operation With Complete Loss of Zone Temperature Control

[Passenger]

[Option – °F]

If CACTCS control of cabin temperature zones fails, or all engine and APU electrical power fails, the air supply and cabin pressurization controllers control the pack flow control valves. Pack flow rate is modulated to achieve a pack outlet temperature between 40 and 110 degrees F. All flight deck ECS controls are disabled except the PACK switches.

[Passenger]

[Option – °C]

If CACTCS control of cabin temperature zones fails, or all engine and APU electrical power fails, the air supply and cabin pressurization controllers control the pack flow control valves. Pack flow rate is modulated to achieve a pack outlet temperature between 5 and 43 degrees C. All flight deck ECS controls are disabled except the PACK switches.

[Freighter]

If CACTCS control of cabin temperature zones fail, or all engine and APU electrical power fails, the air supply and cabin pressurization controllers control the pack flow control valves. Pack flow rate is modulated to achieve a pack outlet temperature between 40°F and 110°F (5°C and 43°C). All flight deck ECS controls are disabled except the PACK switches.

Shoulder and Foot Heaters

Flight crew shoulder heat is provided by electric elements in the side window air diffusers. The foot heaters have electric heating elements only, with no airflow. Both are available in flight only.

Flight Deck Humidification System

[Option]

The humidification system operates during cruise when the HUMID switch is ON. The system uses water from the potable water system to introduce moisture into the circulation air. Minerals in the potable water may precipitate as solids when the humidification system operates. These solids may circulate in the cabin as dust or haze.

Gasper System

[Option]

The gasper system fan supplies conditioned air from the aft cabin distribution duct to the passenger service unit air gasper outlets above each passenger seat.

Cargo Temperature Control System

Cargo Heat System

[Passenger]

The aft and bulk cargo compartments have independent bleed air heating systems. An insulated curtain separates the two compartments.

[Passenger]

With the CARGO TEMP selector in LOW or HIGH, the respective cargo heat shutoff valve opens and the temperature control valve opens and closes to maintain the temperature in the compartment. The lavatory/galley vent fans draw air across temperature sensors in each compartment. If both vent fans fail, cargo heat is not provided.

[Passenger]

[Option – °F]

With the CARGO TEMP selector in LOW and TAT less than 45 degrees F, the respective temperature control valve opens. The compartment temperature is maintained between 40 and 50 degrees F. With the CARGO TEMP selector in HIGH and TAT less than 70 degrees F, the respective temperature control valve opens. The compartment temperature is maintained between 65 and 75 degrees F.

[Passenger]
[Option – °C]

With the CARGO TEMP selector in LOW and TAT less than 7 degrees C, the respective temperature control valve opens. The compartment temperature is maintained between 4 and 10 degrees C. With the CARGO TEMP selector in HIGH and TAT less than 21 degrees C, the respective temperature control valve opens. The compartment temperature is maintained between 18 and 24 degrees C.

[Passenger]

With the BULK CARGO TEMP selector in HIGH the bulk ventilation fan operates. The fan is provided for animal carriage. The system has automatic overheat protection. When an automatic overheat shutdown occurs, cargo heat to the related compartment cannot be restored in flight.

[Freighter]
[Option – Lower Aft Cargo A/C]

With the LWR CARGO TEMP AFT selector in LOW and TAT less than 45°F (7°C) the temperature control valve opens. The compartment temperature is maintained between 40°F and 50°F (4°C and 10°C). With the selector in HIGH and TAT less than 70°F (21°C), compartment temperature is maintained between 65°F and 75°F (18°C and 24°C).

The lower forward cargo compartment is heated by warm air from the forward equipment ventilation system.

Forward Cargo Compartment Air Conditioning System

[Passenger]
[Option – Forward Cargo A/C]

With the FWD CARGO A/C selector in AUTO, the forward cargo heating system is shut off and a selected temperature is displayed on the AIR synoptic.

Automatic ventilation ensures that smoke and objectionable odors do not enter the flight deck or passenger cabin.

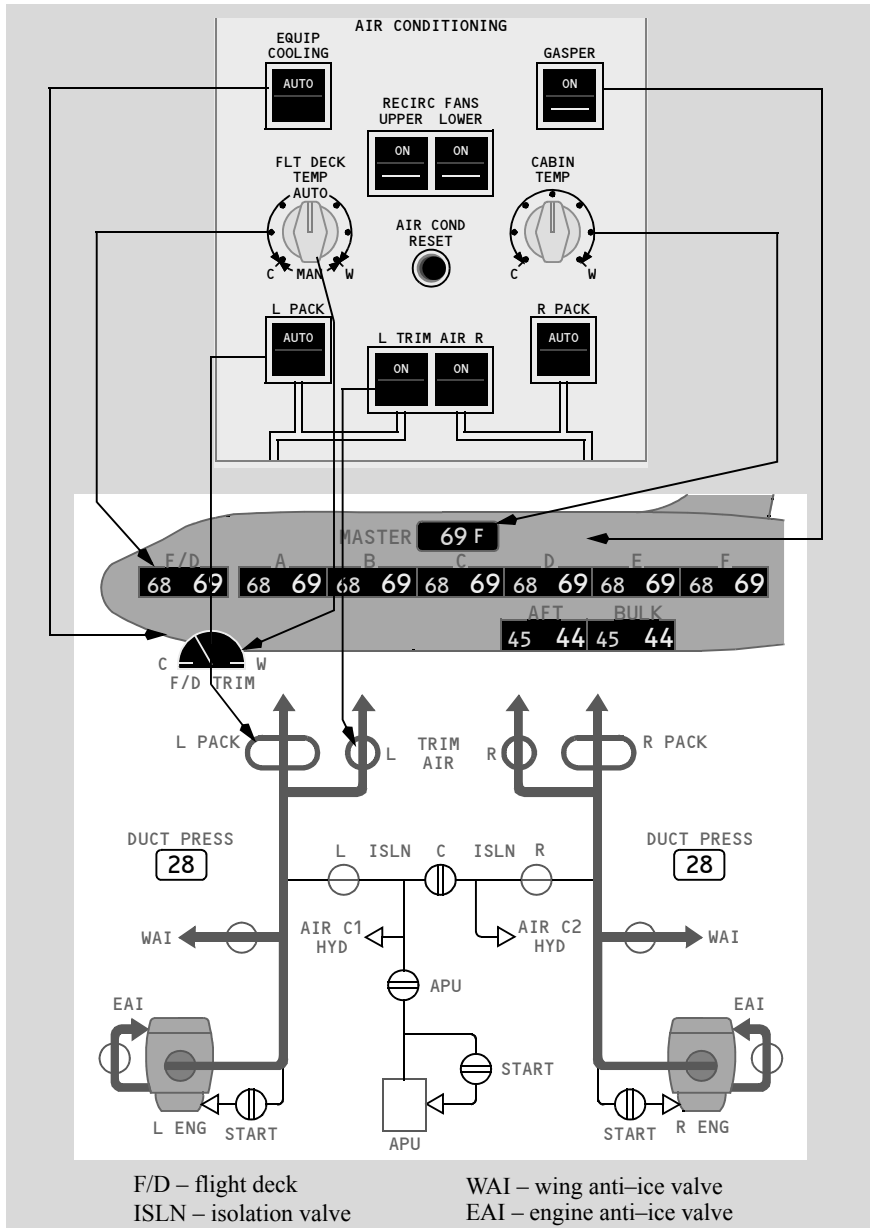
If the selector setting is not available because of system failure, the packs maintain the last temperature set by the FWD CARGO A/C selector.

Lower Cargo Air Conditioning System

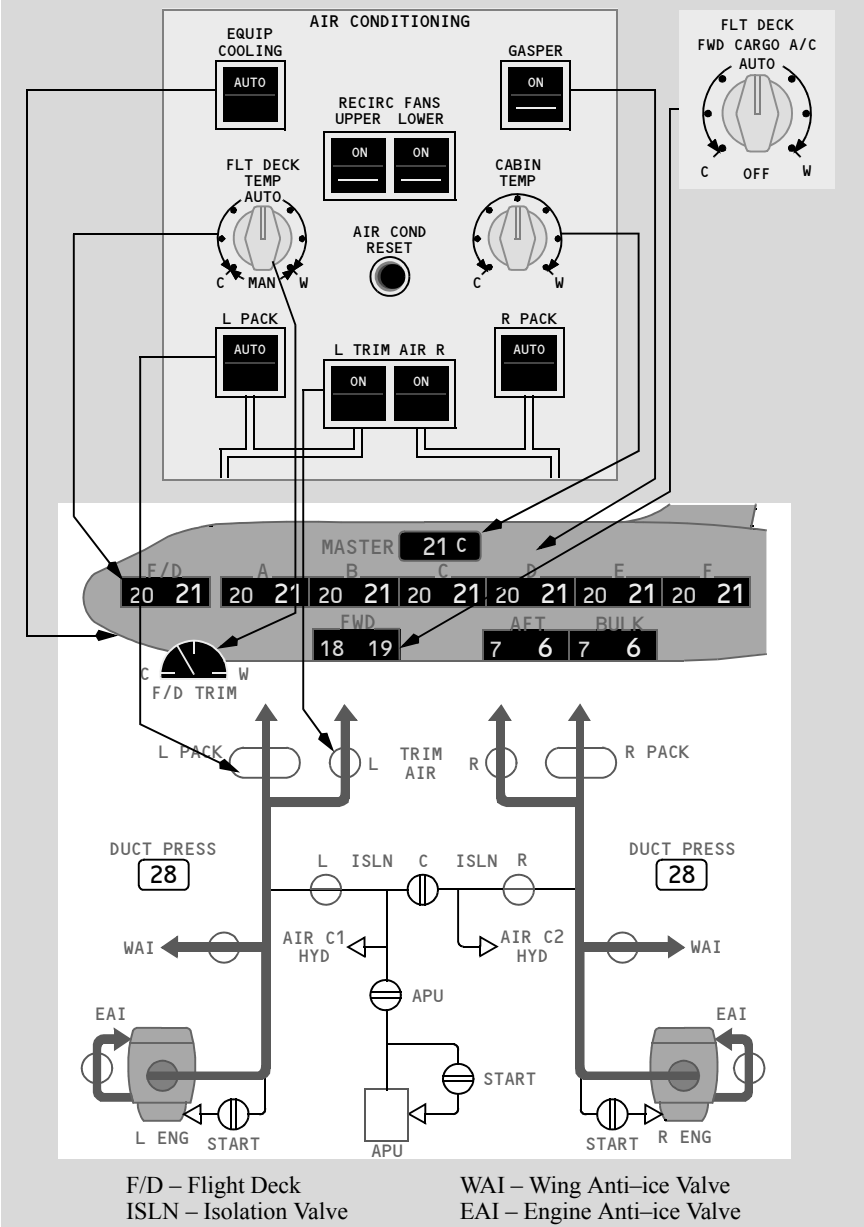
[Freighter]
[Option - Lower Aft Cargo A/C]

With the LWR CARGO TEMP FWD A/C selector or the LWR CARGO TEMP AFT A/C selector in AUTO, the respective cargo heating system is shut off and a selected temperature for the compartment is displayed on the AIR synoptic.

If a lower cargo temperature selector setting is not available because of system failure, the packs maintain the temperature of that compartment to the last temperature set by the respective forward or aft selector.

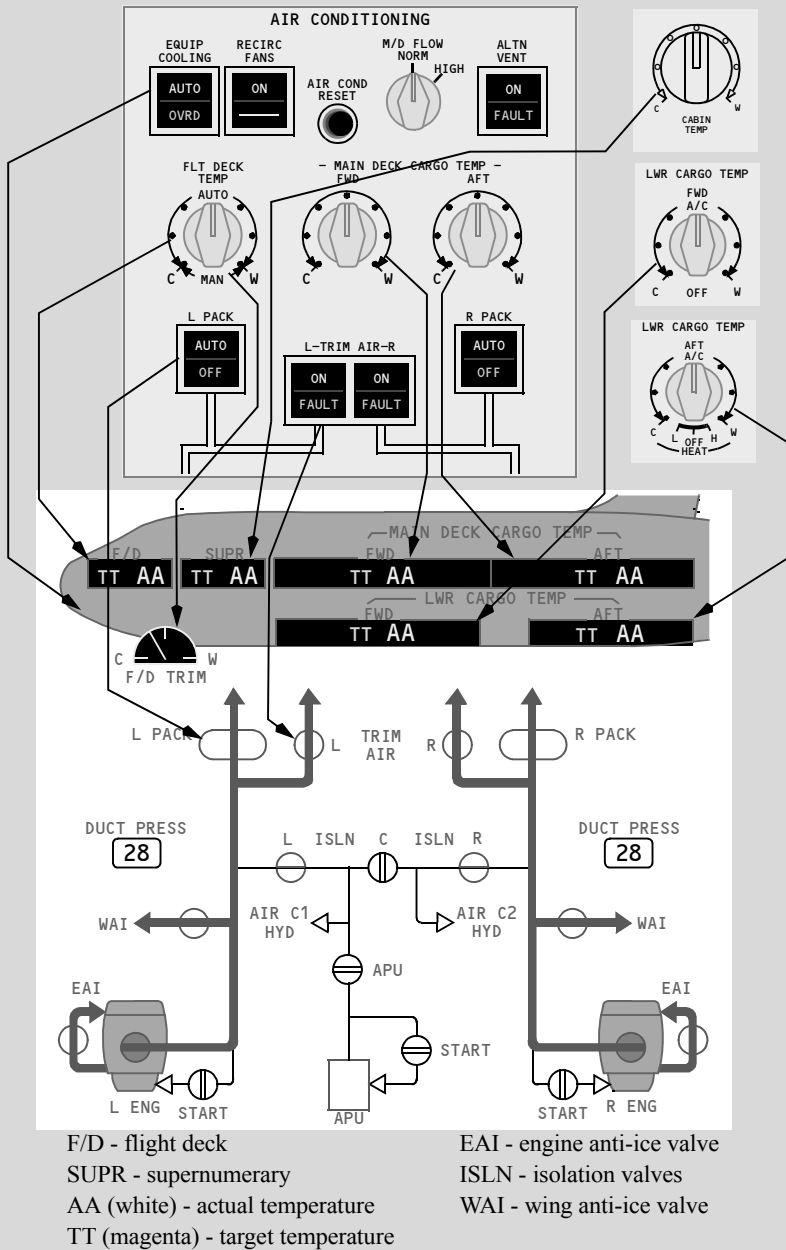
Air Conditioning System Schematic

[Passenger]
[Options – °C, Gasper, Fwd Cargo A/C]



[Freighter]

[Option - Lower Aft Cargo A/C]



Equipment Cooling, Equipment Ventilation, Lavatory and Galley Ventilation

The forward equipment cooling and ventilation provides cooling and ventilation for the electrical and electronic equipment on the flight deck and in the forward electrical and electronic (E & E) compartment equipment racks.

[Passenger]

The forward systems use internal fans and valves to direct air drawn from the cabin to the equipment and ventilates the warm exhaust air into the forward outflow valve or the forward cargo compartment, if the compartment requires additional heat. There are two cooling system supply fans, a primary and a backup. If the primary supply fan fails, the backup supply fan operates automatically.

[Freighter]

The forward systems use internal fans and valves to direct conditioned pack air to the equipment and ventilates the warm exhaust air into the forward outflow valve or the lower forward cargo compartment if the compartment requires additional heat. There are two cooling system supply fans, a primary and a backup. If the primary supply fan fails, the backup supply fan operates automatically.

The forward system reconfigures automatically to an override mode when:

- in flight, both supply fans fail, or
- in flight, low airflow is detected, or
- smoke is detected in the forward equipment cooling system or the forward equipment ventilation system, or

[Passenger]

- the FWD CARGO FIRE ARM switch is ARMED, or

[Freighter]

[Option – Lower Aft Cargo A/C]

- the LWR AFT CARGO FIRE ARM switch is ARMED, or

[Freighter]

- the LWR FWD CARGO FIRE ARM switch is ARMED
- the EQUIP COOLING switch is in OVRD

[Passenger]

In the override mode when the FWD CARGO FIRE ARM switch is not ARMED, the vent valve opens, both supply fans shut down, and the forward cargo heat valve closes. In the override mode when the FWD CARGO FIRE ARM switch is ARMED, the vent valve remains closed, both supply fans remain shut down, and the forward cargo heat valve is closed. Cabin differential pressure draws air through the flight deck panels and into the E & E equipment compartment to create a reverse flow of air across the equipment, then through the override valve to an overboard vent.

[Freighter]

In the override mode when the LWR FWD CARGO FIRE ARM switch is not ARMED, the vent valve opens, both supply fans shut down, and the lower forward cargo heat valve closes. In the override mode when the LWR FWD CARGO FIRE ARM switch is ARMED, the vent valve remains closed, both supply fans remain shut down, and the lower forward cargo heat valve is closed. Cabin differential pressure draws air through the flight deck panels and into the E & E equipment compartment to create a reverse flow of air across the equipment, then through the override valve to an overboard vent.

[Freighter]

When the MAIN DECK FIRE switch is ARMED, the system is configured to supply conditioned air to the flight deck and the air is exhausted through the ventilation system into the lower forward cargo compartment.

In flight, the EQUIP COOLING switch in OVRD aids smoke evacuation from the flight deck.

The override mode supplies adequate airflow for equipment cooling while the airplane is in cruise. During descent, the airflow decreases as the cabin pressure differential decreases.

On the ground, the EICAS advisory message EQUIP COOLING is displayed and the ground crew call horn in the wheel well sounds if the forward equipment cooling system is inoperative.

[Passenger]

The aft equipment cooling and ventilating system provides cooling and ventilating air for the aft electronic equipment and ventilating air for the lavatories and galleys. Two aft ventilation fans, a primary and a backup, draw air through the aft electronic equipment and from the galleys and lavatories. The warm exhaust air is discharged through the aft outflow valve. Conditioned air is supplied to the galleys from the air distribution system.

[\[Freighter\]](#)

The aft equipment cooling and ventilating system provides cooling and ventilating air for the aft electronic equipment and ventilating air for the lavatory and galley. Two aft ventilation fans, a primary and a backup, draw air through the aft electronic equipment and from the galley and lavatory. The warm exhaust air is discharged through the aft outflow valve. Conditioned air is supplied to the galley from the air distribution system.

Air Systems**Pressurization System Description****Chapter 2****Section 30**

Introduction

Cabin pressurization is controlled by regulating the discharge of conditioned cabin air through the outflow valves.

Two outflow valves are installed: one forward and one aft. Normally, most of the outflow is through the aft outflow valve. This improves ventilation and smoke removal. Cabin altitude and full ventilation rates can be maintained by either valve.

Positive and negative pressure relief valves protect the fuselage against excessive pressure differential.

The pressurization system has automatic and manual operating modes. Other than accomplishing normal procedures for entering FMC data, no specific flight crew action is required for fully automatic operation.

Pressurization System Automatic Operation

In flight, the cabin altitude controller operates in a climb mode, a cruise mode, or a descent mode.

The controller uses ambient pressure and flight plan data from the FMC to calculate a cabin pressurization schedule. The schedule provides a comfortable cabin climb to cruise altitude.

For takeoff, the system supplies a small positive pressurization prior to rotation to cause a smooth cabin altitude transition to the cabin altitude climb schedule.

In cabin altitude controller climb mode, cabin altitude increases on a schedule related to the airplane climb rate and flight plan cruise altitude. When the FMC climb path has a planned level segment, it is included in the total time required for the airplane to reach the top of climb. Cabin altitude continues to increase during the level segment. When the airplane climb flight path is above the FMC climb path and maximum cabin pressure differential is reached during the climb, cabin rate then becomes a function of airplane climb rate so maximum cabin differential pressure is not exceeded.

If cruise altitude is unavailable from the FMC in AUTO, the cabin altitude controllers assume a cruise altitude of 39,000 feet.

In cabin altitude controller cruise mode, maximum cabin altitude is 8,000 feet. When the takeoff field elevation is higher than 8,000 feet, the cabin descends to the cabin cruise altitude while the airplane is climbing.

When the destination airport elevation is greater than 8,000 feet, cabin altitude controller cruise mode maintains a cabin altitude of 8,000 feet.

The cabin altitude controllers enter cabin altitude controller descent mode at T/D or at initial descent of approximately 1,000 feet from cruise altitude, regardless of T/D.

In cabin altitude descent mode, cabin altitude decreases or increases to slightly below the FMC planned landing altitude in AUTO or the landing altitude set in MAN. The slight altitude difference ensures a small positive pressurization at touchdown. In MAN, FMC altitude information is bypassed and the cabin altitude controller uses internal rate schedules to control cabin altitude.

Landing elevation limits are 1,000 feet below sea level to 14,000 feet above sea level. The captain's altimeter setting provides landing altitude barometric pressure correction.

At touchdown, the outflow valves open to depressurize the cabin.

The cabin altitude limiter closes both outflow valves if cabin altitude exceeds 11,000 feet.

Full automatic operation of cabin altitude is possible with one outflow valve operating automatically and the other outflow valve not operating.

Cabin Altitude Controller Automatic Operation With Loss of Landing Altitude

If landing altitude is unavailable from the FMC, and not set in MAN, the EICAS advisory message LANDING ALT is displayed and the cabin altitude controller assumes a landing altitude of 2,000 feet.

Pressurization System Manual Operation

If both OUTFLOW VALVE switches are in MAN, all automatic cabin altitude control functions are bypassed.

Air Systems**Chapter 2****Bleed Air System Description****Section 40**

Introduction

Bleed air can be supplied by the engines, APU, or a ground air source.

Bleed air is used for:

- air conditioning
- pressurization
- wing and engine anti-ice
- APU and engine start
- aft cargo heat
- air driven hydraulic pumps
- hydraulic reservoir pressurization
- potable water tank pressurization
- TAT probe aspiration.

Engine Bleed Air Supply

Engine bleed air is supplied from either the high stage or the low stage engine sections. Low stage air is used during high power setting operations. High stage air is used during descent and other low power setting operations.

The engine bleed air valves are armed when the ENGINE bleed switches are selected ON. The valves are pressure actuated and remain closed until engine bleed air pressure is sufficient to cause forward flow. The engine bleed valves close automatically:

- during start
- for bleed source loss
- for bleed air overtemperature
- for bleed air overpressure
- for a bleed air duct leak
- when an engine fire switch is pulled
- when a ground cart is supplying air.

APU Bleed Air Supply

APU bleed air is used primarily during ground operations for pack operation and engine starting. In flight, APU bleed air is available below approximately 22,000 feet.

The check valve in the APU supply line prevents reverse flow of bleed air from the duct into the APU.

APU to Pack Takeoff

Before engine start, selecting APU from the FMC scratch pad to the SEL-APU field on the THRUST LIMIT PAGE arms the system for APU to pack takeoff. Approximately one minute after starting the second engine, the bleed air supply system configures for APU to pack takeoff.

When APU is selected to the SEL-APU field after both engines are running but before takeoff, the bleed air supply immediately configures for APU to pack takeoff.

In APU to pack takeoff configuration:

- the left engine bleed valve is closed,
- the L ENG OFF light is illuminated and remains illuminated,
- the APU provides air to air demand pump C1 and the left pack,
- the center bleed isolation valve is closed,
- the right engine provides air to air demand pump C2,
- the right pack valve is closed, and
- the R PACK OFF light is illuminated and remains illuminated.

The system reconfigures from APU to pack takeoff to normal operation when:

- thrust is reduced to climb thrust, or
- approximately 10 minutes after takeoff, or
- the airplane is above 11,400 feet altitude, or
- APU to pack configuration cannot be continued because of failures in other systems, or
- APU to pack mode is deleted manually.

Ground Bleed Air Supply

External connectors are provided to connect a ground source of high pressure air directly to the bleed air duct.

Check valves prevent reverse flow of bleed air from the bleed air duct to the connectors.

Bleed Air Duct System

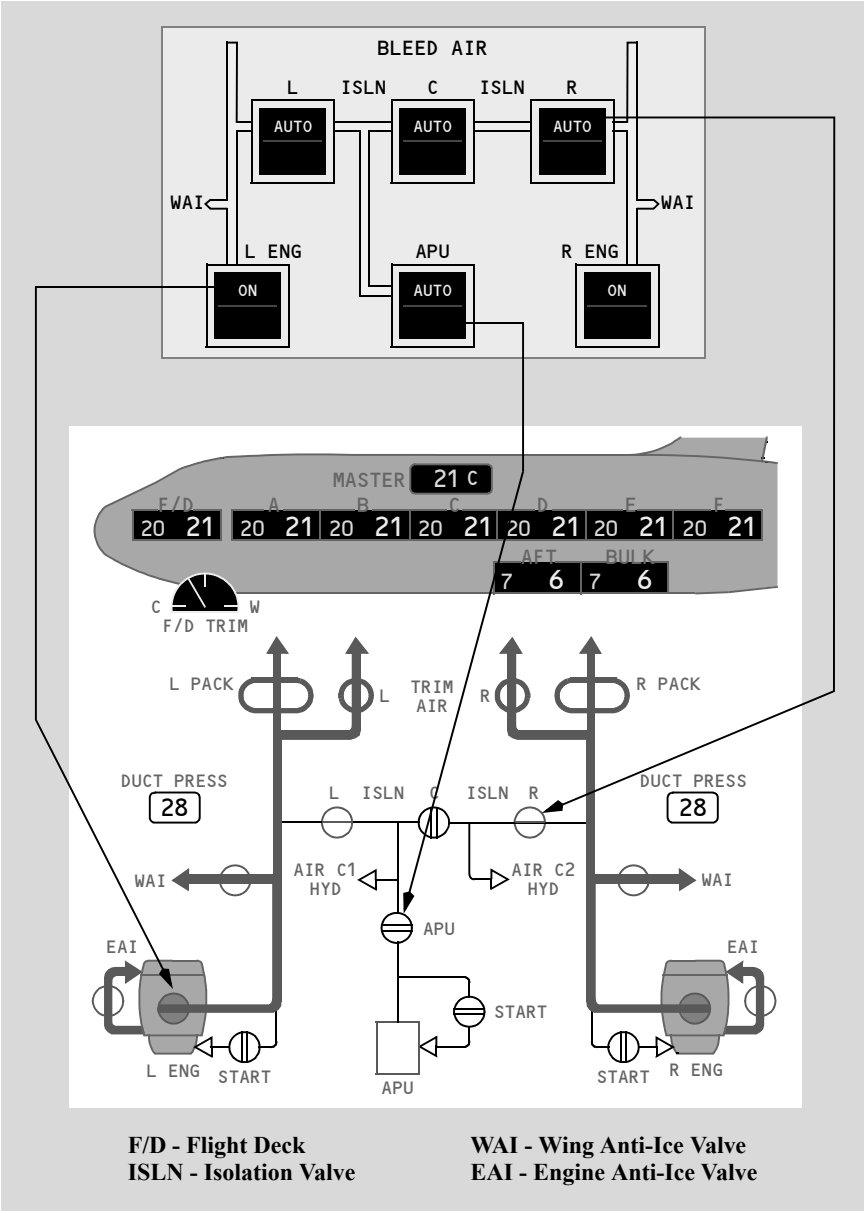
The left, center, and right isolation valves separate the bleed air duct into isolated segments. The automatic system operates with the left and right isolation valves normally open. The center isolation valve is normally closed, except for engine start or single bleed source operation.

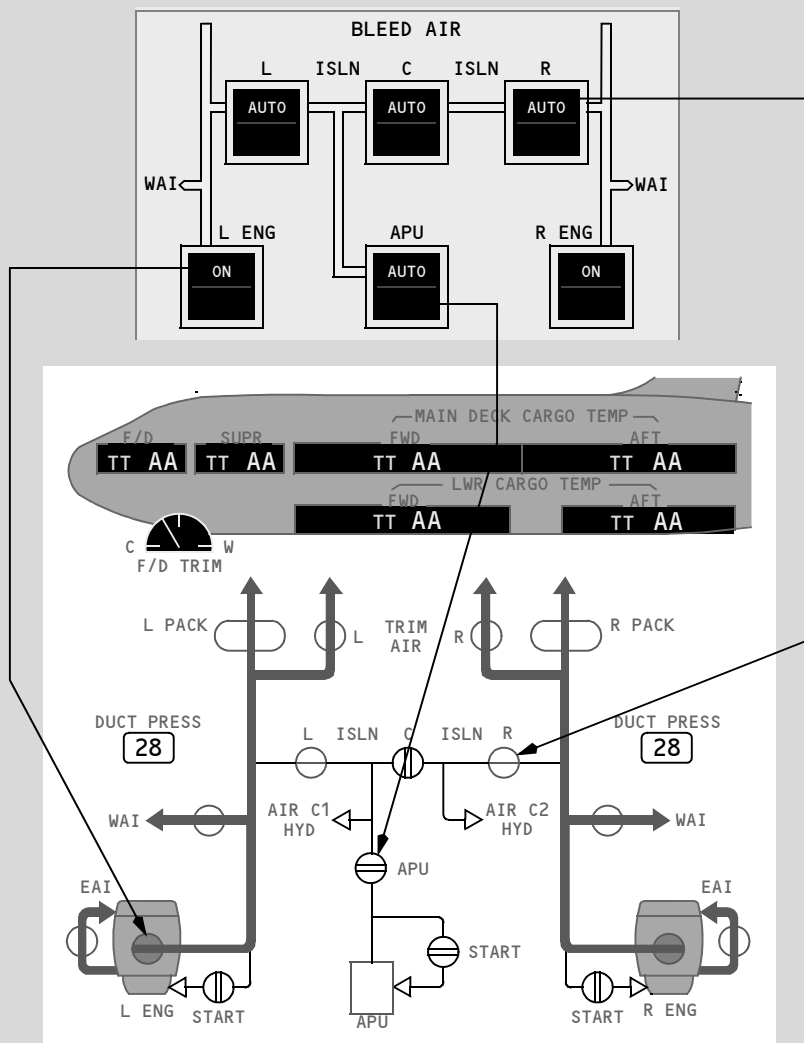
Duct Leak and Overheat Detection System

If a duct leak is detected, the system automatically isolates the leak. The EICAS caution message BLEED LEAK is displayed. The automatic isolation logic may include one, two, or three sequential steps. During isolation, the ENGINE and/or APU bleed switch OFF lights and the ISOLATION switch CLOSED lights illuminate and extinguish as the respective valves close and open.

When the temperature in the affected duct area cools, the BLEED LEAK EICAS message is no longer displayed. The valves isolating the leak remain closed and the appropriate EICAS message BLEED LOSS is displayed. The switch OFF or CLOSED lights are illuminated for the respective valves which remain closed to isolate the affected duct area.

Bleed Air System Schematic





F/D - flight deck
 SUPR - Supernumerary
 AA (white) - actual temperature
 TT (magenta) - target temperature

EAI - engine anti-ice valve
 ISLN - isolation valves
 WAI - wing anti-ice valve

Intentionally
Blank

Air Systems**Chapter 2****Air Systems EICAS Messages****Section 50****Air Systems EICAS Alert Messages**

Message	Level	Aural	Message Logic
---------	-------	-------	---------------

[Freighter]

ALTN VENT SYS	Advisory		The alternate ventilation system is failed when commanded to operate.
---------------	----------	--	---

BLEED ISLN CLOSED C, L, R	Advisory		Isolation valve remains closed when commanded open or bleed isolation switch is OFF.
BLEED ISLN OPEN C, L, R	Advisory		Isolation valve remains open when commanded closed.
BLEED LEAK BODY	Caution	Beeper	High temperature bleed air leak is detected in the body area.
BLEED LEAK L, R	Caution	Beeper	High temperature bleed air leak is detected in the wing or pack bay area.
BLEED LEAK STRUT L, R	Caution	Beeper	High temperature bleed air leak is detected in the strut area.
BLEED LOSS BODY	Advisory		Bleed air from the left and right body ducts is no longer available.
BLEED LOSS BODY L, R	Advisory		Bleed air from the body duct is no longer available.
BLEED LOSS WING L, R	Advisory		Bleed air from the wing duct is no longer available.
BLEED OFF APU	Advisory		APU bleed valve is closed for a system fault or APU bleed switch is OFF.
BLEED OFF ENG L, R	Advisory		Engine bleed valve is closed for a system fault or engine bleed switch is OFF.
CABIN ALTITUDE	Warning	Siren	Cabin altitude is excessive.
CABIN ALTITUDE AUTO	Caution	Beeper	Automatic pressurization control has failed or both outflow valve switches are in manual.

Message	Level	Aural	Message Logic
---------	-------	-------	---------------

[Freighter]

CABIN TEMPERATURE	Advisory		Flight deck or cabin temperature uncontrollable and pack failed to shutdown.
-------------------	----------	--	--

[Passenger]

[Option - Forward Cargo Air Conditioning]

CARGO A/C FWD	Advisory		The forward cargo air conditioning is inoperative.
---------------	----------	--	--

[Freighter]

[Option - Lower Aft Cargo Air Conditioning]

CARGO A/C LWR AFT	Advisory		Loss of lower aft cargo temperature control.
-------------------	----------	--	--

[Freighter]

CARGO A/C LWR FWD	Advisory		Loss of lower fwd cargo temperature control.
-------------------	----------	--	--

[Freighter]

CARGO HEAT AFT	Advisory		Cargo heat is inoperative or cargo temperature selector is OFF.
----------------	----------	--	---

[Passenger]

CARGO HEAT AFT, BULK	Advisory		Cargo heat is inoperative or cargo temperature selector is OFF.
----------------------	----------	--	---

EQUIP COOLING	Advisory		Forward equipment cooling is inoperative.
EQUIP COOLING OVRD	Advisory		Equipment cooling system is in override mode.
LANDING ALTITUDE	Advisory		FMC has failed to provide a landing altitude or landing altitude selector is pulled.

Message	Level	Aural	Message Logic
---------	-------	-------	---------------

[\[Freighter\]](#)

MAIN DECK A/C	Advisory		Loss of forward or aft maind temperature control.
---------------	----------	--	---

OUTFLOW VALVE AFT, FWD	Advisory		Automatic control has failed or outflow valve switch is in MAN.
------------------------	----------	--	---

PACK L, R	Advisory		Pack is shut down.
-----------	----------	--	--------------------

[\[AIMS BP03 installed\]](#)

PACK L+R	Caution	Beeper	Both packs are shut down.
----------	---------	--------	---------------------------

PACK MODE L, R	Advisory		Pack is operating in standby mode.
----------------	----------	--	------------------------------------

TRIM AIR L, R	Advisory		Trim air is shut off.
---------------	----------	--	-----------------------

EICAS Memo Messages

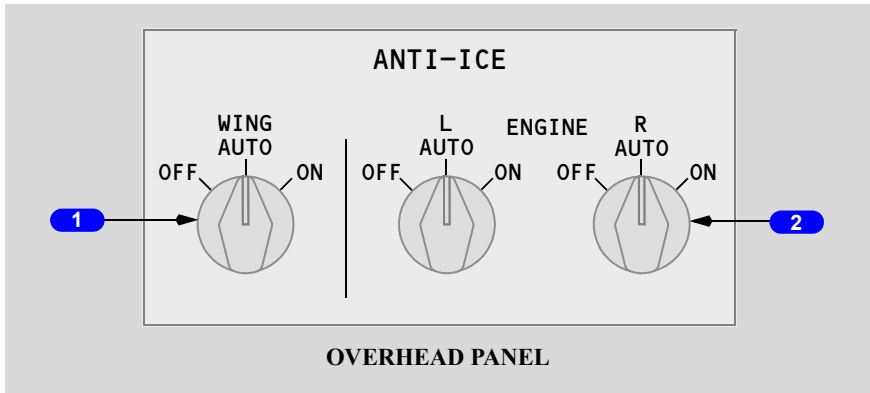
Message	Level	Aural	Message Logic
RECIRC FANS OFF	Memo		One or both recirculation fan switches are in the off position.

Intentionally
Blank

Anti-Ice, Rain**Chapter 3****Table of Contents****Section 0**

Controls and Indicators	3.10
Engine and Wing Anti Ice	3.10.1
Anti-Ice Panel	3.10.1
Anti-Ice Indications	3.10.2
Window Heat and Wiper Panels	3.10.3
Window Heat Panel	3.10.3
Wiper Panels	3.10.3
System Description	3.20
Introduction	3.20.1
Automatic Ice Detection System	3.20.1
Engine Anti-Ice System	3.20.1
Engine Anti-Ice System Automatic Operation	3.20.1
Engine Anti-Ice System Manual Operation	3.20.1
Engine Anti-Ice Leak Detection System	3.20.1
Wing Anti-Ice System	3.20.2
Wing Anti-Ice System Automatic Operation	3.20.2
Wing Anti-Ice System Manual Operation	3.20.2
Wing Anti-Ice System Leak Detection System	3.20.2
Anti-Ice System Schematic	3.20.3
Flight Deck Window Heat	3.20.3
Windshield Wipers	3.20.3
Probe Heat	3.20.4
EICAS Messages	3.30
Anti-Ice, Rain System EICAS Messages	3.30.1

Intentionally
Blank

**Anti-Ice, Rain
Controls and Indicators****Chapter 3
Section 10****Engine and Wing Anti Ice****Anti-Ice Panel****1 WING ANTI-ICE Selector**

OFF – both wing anti-ice valves are commanded closed.

AUTO – in flight, both wing anti-ice valves are commanded opened or closed automatically by the ice detection system.

ON – in flight, both wing anti-ice valves are commanded open.

2 ENGINE ANTI-ICE Selectors

OFF – the engine anti-ice valve is commanded closed.

AUTO – in flight, the engine anti-ice valve is opened or closed automatically by the ice detection system.

ON – the engine anti-ice valve is commanded open.

Note: If the ENGINE ANTI-ICE selector is in AUTO and the anti-ice valve is commanded open, or if the selector is in ON, then:

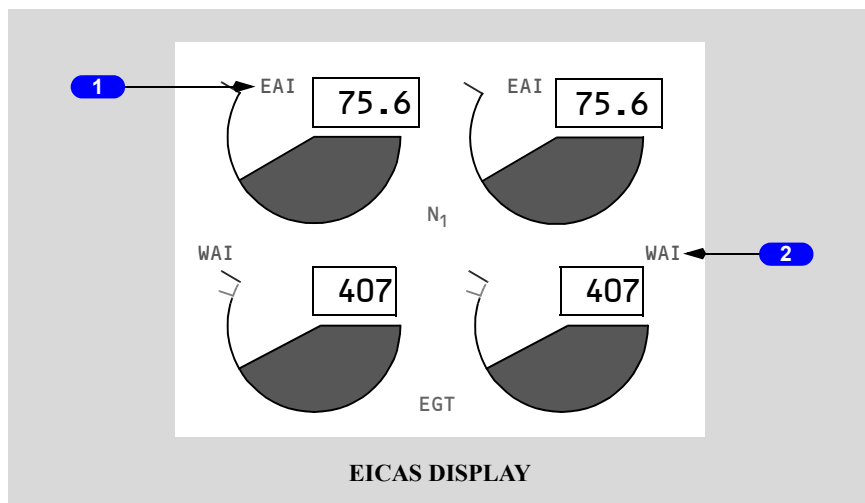
[Options – PW Engines]

- approach idle is selected by the EEC and continuous ignition is automatically turned on

[Option – RR, GE Engines]

- approach idle is selected by the EEC

Anti-Ice Indications



1 Engine Anti-ice Indication

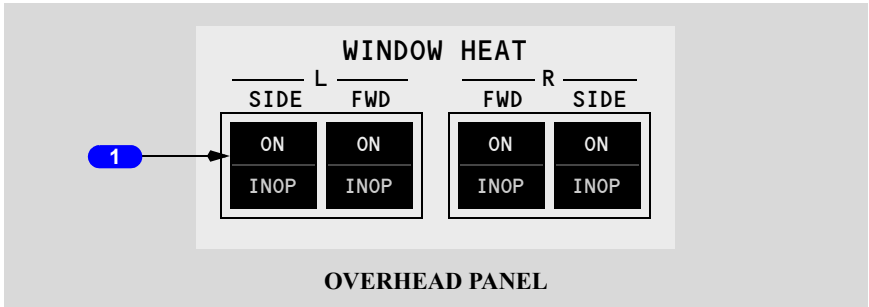
Displayed (green) – engine anti-ice is on.

2 Wing Anti-Ice Indication

Displayed (green) – wing anti-ice is on.

Window Heat and Wiper Panels

Window Heat Panel



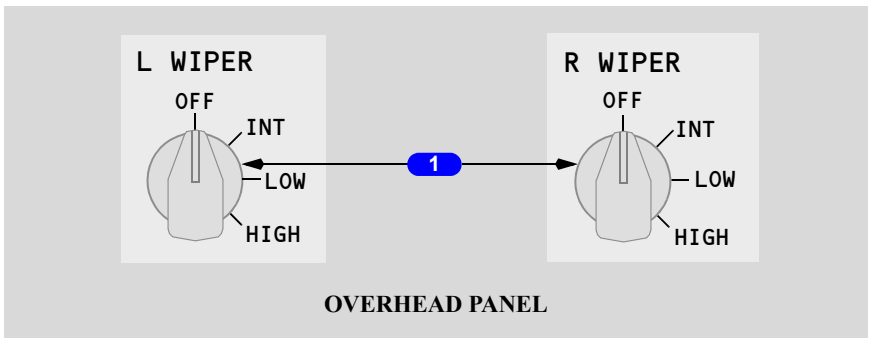
1 WINDOW HEAT Switches

ON – window heat is applied to the selected windows.

INOP (inoperative) illuminated (amber) –

- the switch is OFF
- an overheat is detected, or
- a system fault has occurred

Wiper Panels



1 WIPER Selectors

OFF – the wiper is stowed at the base of the window.

INT (intermittent) – the wiper operates intermittently.

LOW – the wiper operates at low speed.

HIGH – the wiper operates at high speed.

Intentionally
Blank

Anti-Ice, Rain System Description

Chapter 3 Section 20

Introduction

The anti-ice and rain systems include:

- automatic ice detection
- engine anti-ice
- wing anti-ice
- flight deck window heat
- windshield wipers
- probe heat

Automatic Ice Detection System

The automatic ice detection system detects airplane icing in flight. The system consists of two ice detector probes on the forward fuselage. The system provides signals to control the engine and wing anti-ice systems when those systems are in the automatic mode.

Automatic ice detection is inhibited on the ground.

Engine Anti-Ice System

The engine anti-ice system uses engine bleed air to provide engine cowl inlet ice protection. Engine anti-ice can be operated in flight or on the ground. The engine anti-ice indication EAI is displayed above the EICAS N1 indication when an engine anti-ice valve is open. The left and right engines have identical, independent anti-ice systems. This allows the remaining system to operate if one engine is shutdown.

Engine Anti-Ice System Automatic Operation

In flight, when the ENGINE ANTI-ICE selector is in AUTO, engine anti-ice system operation is automatic. When ice is detected, the engine anti-ice valves open and bleed air is supplied to the engine inlet cowl.

When ice is no longer detected, the engine anti-ice valves close and bleed air is no longer supplied to the engine inlet cowl.

Engine Anti-Ice System Manual Operation

On the ground or in flight, when the ENGINE ANTI-ICE selector is ON, engine bleed air opens the engine anti-ice valve and bleed air is supplied to the engine inlet cowl.

Engine Anti-Ice Leak Detection System

Each engine has an anti-ice system duct leak detection system. If an anti-ice duct leak is detected, the respective engine anti-ice valve closes.

Wing Anti-Ice System

The wing anti-ice system provides bleed air to three midwing leading edge slats on each wing. Wing anti-ice is inhibited on the ground. When TAT is above 10 degrees C, wing anti-ice is inhibited for five minutes after takeoff.

The wing anti-ice annunciation WAI is displayed below the EICAS N1 indication when a wing anti-ice valve is open. If a bleed source is unavailable and bleed duct isolation has not occurred, the isolation valves open automatically to maintain anti-icing to both wings.

Wing Anti-Ice System Automatic Operation

In flight, when the WING ANTI-ICE selector is in AUTO, wing anti-ice system operation is automatic. When ice is detected, the wing anti-ice valves open and bleed air is supplied to the leading edge slats. When ice is no longer detected, the wing anti-ice valves close and bleed air is no longer supplied to the slats. If one wing anti-ice valve fails closed, the wing anti-ice system automatically closes the other valve to prevent asymmetrical wing anti-icing.

Automatic wing anti-ice operation is also inhibited when all the following conditions are true:

- TAKEOFF Mode is selected,
- Wing icing is detected in AUTO mode, and
- It is less than 10 minutes from ground to air transition

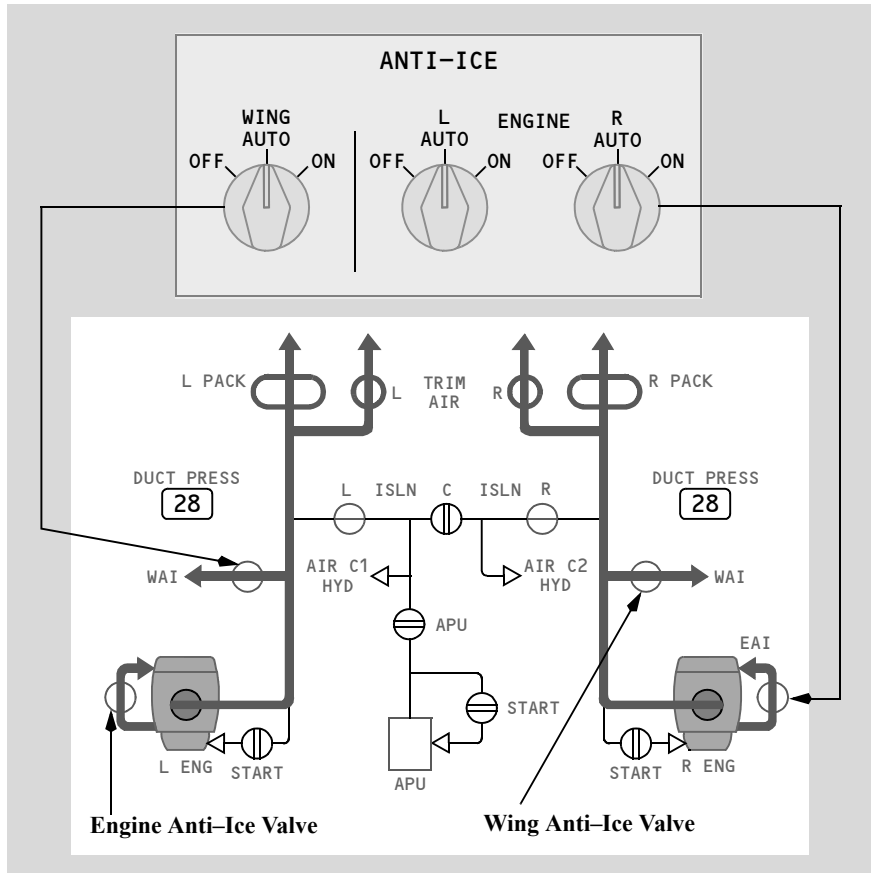
Wing Anti-Ice System Manual Operation

In flight, when the WING ANTI-ICE selector is ON the wing anti-ice valve in each wing opens and bleed air is supplied to the leading edge slats.

Wing Anti-Ice System Leak Detection System

The bleed duct leak and overheat detection system provides wing anti-ice leak detection. Refer to Chapter 2, Air Systems, Bleed Air System Description.

Anti-Ice System Schematic



Flight Deck Window Heat

All flight deck windows are electrically heated. The forward windows have exterior surface anti-icing, and interior surface anti-fogging protection. The side windows have interior surface anti-fogging protection only.

The WINDOW HEAT switches control heating for all flight deck windows.

A backup anti-fogging system for the forward windows operates automatically if the primary window heat system fails.

Windshield Wipers

The forward windows are equipped with independently controlled, three-speed wipers. When the WIPER selector in OFF, the respective wiper is off and stowed.

Probe Heat

Three pitot probes and two angle of attack probes are electrically heated for anti-ice protection when either engine is operating.

The total air temperature probe is electrically heated for anti-ice protection in flight.

**Anti-Ice, Rain
EICAS Messages****Chapter 3
Section 30****Anti-Ice, Rain System EICAS Messages**

The following EICAS messages can be displayed.

Message	Level	Aural	Message Logic
ANTI-ICE ENG L, R	Advisory		Engine anti-ice valve remains closed when commanded open.
ANTI-ICE LEAK ENG L, R	Caution	Beeper	High temperature anti-ice bleed air leak is detected in the affected engine.
ANTI-ICE LOSS ENG L, R	Advisory		Anti-ice bleed air for the affected engine is no longer available.
ANTI-ICE ON	Advisory		Any anti-ice selector is ON, air temperature is above 10 degrees C, and ice is not detected.
ANTI-ICE WING	Advisory		One or both wing anti-ice valves remain closed when commanded open.
HEAT PITOT C	Advisory		Center pitot probe heat is inoperative.
HEAT PITOT L	Advisory		Left pitot probe heat is inoperative.
HEAT PITOT L+C+R	Advisory		All pitot probe heats are inoperative.
HEAT PITOT R	Advisory		Right pitot probe heat is inoperative.
ICE DETECTORS	Advisory		Ice detection has failed.
ICING ENG	Caution	Beeper	Ice is detected and one or both engine anti-ice selectors are OFF.
ICING WING	Advisory		Ice is detected and wing anti-ice selector is OFF, or ice is detected and wing anti-ice takeoff inhibit is active.
WINDOW HEAT	Advisory		Two or more window heats are off.
WINDOW HEAT L, R FWD	Advisory		Primary window heat for the affected forward window is off.
WINDOW HEAT L, R SIDE	Advisory		Window heat for the affected side window is off.

Intentionally
Blank

Automatic Flight**Chapter 4****Table of Contents****Section 0**

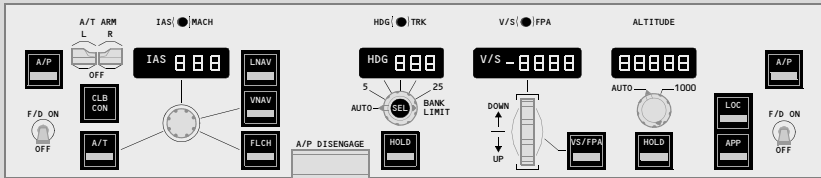
Controls and Indicators	4.10
Mode Control Panel (MCP)	4.10.1
Autopilot Flight Director System Controls	4.10.1
Autothrottle System Controls	4.10.3
Autopilot Flight Director IAS/Mach Controls	4.10.4
Autopilot Flight Director Roll and Pitch Controls	4.10.6
Autopilot Flight Director Heading, Track, and Bank Angle Controls	4.10.9
Autopilot Flight Director Vertical Speed (V/S) and Flight Path Angle (FPA) Controls	4.10.11
Autopilot Flight Director Altitude Controls	4.10.12
Autopilot Flight Director Approach Mode Controls	4.10.14
PFD Flight Mode Annunciations (FMAs)	4.10.16
Autopilot Disconnect Switch	4.10.17
TO/GA and Autothrottle Disconnect Switches	4.10.18
System Description	4.20
Introduction	4.20.1
Autopilot Flight Director System	4.20.1
MCP Mode Selection	4.20.1
Autopilot Engagement	4.20.2
Autopilot Disengagement	4.20.2
Autopilot and Flight Director Mode Degradations	4.20.3
Flight Director Display	4.20.3
Autopilot Flight Director System Schematic	4.20.4
AFDS Status Annunciation	4.20.4
AFDS Flight Mode Annunciations	4.20.5
Autothrottle System	4.20.8
Autothrottle Thrust Lever Operation	4.20.9
Autothrottle Disconnect	4.20.10
Automatic Flight Operations	4.20.10
Automatic Flight Takeoff and Climb	4.20.10

Automatic Flight Takeoff Profile	4.20.12
Automatic Flight En Route	4.20.12
Automatic Flight Approach and Landing	4.20.13
Automatic Flight Approach Profile.	4.20.15
Go-Around	4.20.16
Automatic Flight Go-Around Profile	4.20.18
Automatic Flight Windshear Recovery	4.20.19
Flight Envelope Protection.	4.20.19
EICAS Messages	4.30
Automatic Flight EICAS Messages	4.30.1

Automatic Flight Controls and Indicators

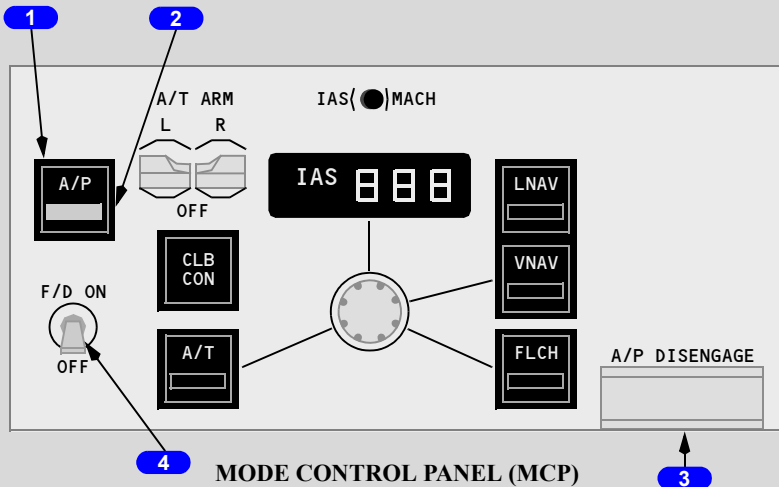
Chapter 4 Section 10

Mode Control Panel (MCP)



GLARESHIELD PANEL

Autopilot Flight Director System Controls



MODE CONTROL PANEL (MCP)

1 Autopilot (A/P) Engage Switches

Push (either switch can engage the autopilot) –

- if either flight director switch is ON, the autopilot engages in the selected flight director mode(s)

[Option – A/P ATT Hold Engage]

- if both flight director switches are OFF, the autopilot engages in:
 - heading hold (HDG HOLD) or track hold (TRK HOLD) as the roll mode, or if bank angle is greater than five degrees, attitude hold (ATT)
 - vertical speed (V/S) or flight path angle (FPA) as the pitch mode.

2 Autopilot Engaged Light

Illuminated (green) – all operating autopilots are engaged.

3 Autopilot (A/P) DISENGAGE Bar

Pull down –

- prevents autopilot engagement
- generates EICAS advisory message NO AUTOLAND
- disables bank angle protection
- exposes the amber and black stripes
- if an autopilot is engaged:
 - it disconnects
 - displays the EICAS warning message AUTOPILOT DISC
 - sounds an aural warning
 - illuminates the master warning lights.

Lift up –

- permits autopilot engagement
- hides the amber and black stripes.

4 Flight Director (F/D) Switches

The left flight director switch activates the flight director steering indications on the left PFD. The right flight director switch activates the flight director steering indications on the right PFD.

ON –

[AFDS -506/-507/-508/-509 s/w not installed]

- On the ground with both flight director switches OFF, the first flight director switch positioned ON arms the flight director in the takeoff go-around (TO/GA) roll and pitch modes. The flight mode annunciation appears on both PFDs. Positioning the second switch ON displays the flight director steering indications on the second PFD.

[AFDS -506/-507/-508/-509 s/w allows ALT mode engagement on gnd]

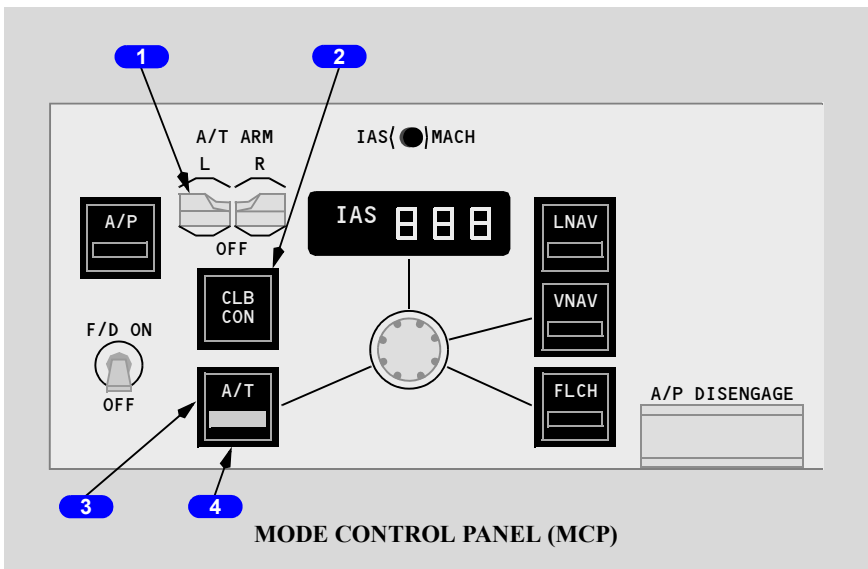
- On the ground with both flight director switches OFF, the first flight director switch positioned ON arms the flight director in takeoff go-around (TO/GA) roll mode. In addition, the first switch arms the flight director in TO/GA pitch mode when MCP selected altitude differs more than 20 feet from displayed baro altitude, or engages the flight director in altitude (ALT) pitch mode when selected altitude is within 20 feet of displayed baro altitude. If ALT mode engages, selecting an altitude more than 20 feet from displayed baro altitude and recycling the first switch arms the flight director in TO/GA roll and pitch modes. The flight mode annunciation appears on both PFDs. Positioning the second switch ON displays the flight director steering indications on the second PFD.

[Option – A/P ATT Hold Engage]

- In flight, with the autopilot disengaged and both flight director switches OFF, the first flight director switch positioned to ON engages the flight director in:
 - heading hold (HDG HOLD) or track hold (TRK HOLD) as the roll mode, or if bank angle is greater than five degrees, attitude hold (ATT)
 - vertical speed (V/S) or flight path angle (FPA) as the pitch mode.
- In flight, with the autopilot engaged and both flight director switches OFF, the first flight director switch positioned to ON engages the flight director in the currently selected autopilot mode(s).

OFF –

- the flight director steering indications are not displayed
- the flight director steering indications are displayed on the PFDs if a TO/GA switch is pushed when airspeed is greater than 80 knots on takeoff, or on a go-around with the flaps not retracted.

Autothrottle System Controls**1 Autothrottle (A/T) ARM Switches**

The left autothrottle arm switch controls the left engine autothrottle. The right autothrottle arm switch controls the right engine autothrottle.

L and/or R – arms the selected autothrottle for mode activation. The selected autothrottle activates when an AFDS mode (VNAV, FLCH, or TO/GA) is selected.

OFF –

- disconnects the selected autothrottle
- prevents selected autothrottle activation.

2 Climb/Continuous (CLB/CON) Thrust Switch

On the ground and below 400 feet during takeoff, the switch is inoperative.

Push –

- with two engines operating, changes the engine thrust limit to the FMC selected climb thrust
- with only one engine operating, changes the thrust limit to maximum continuous (CON).

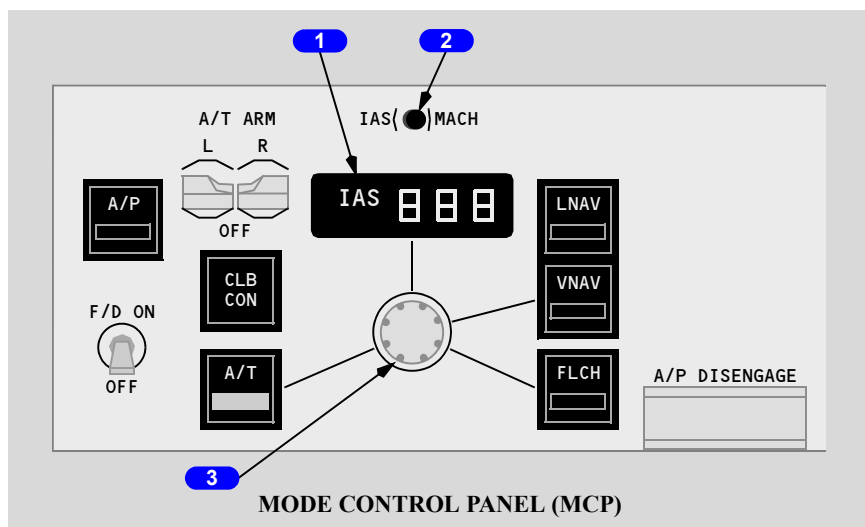
3 Autothrottle (A/T) Switch

Push – above 400 feet, with the autothrottle armed, activates the appropriate autothrottle mode for the selected AFDS pitch mode, or if no pitch mode, in the speed (SPD) mode.

4 Autothrottle Light

Illuminated (green) – an autothrottle mode is activated.

Autopilot Flight Director IAS/Mach Controls



1 IAS/MACH Window

Displays the speed selected by the IAS/MACH selector.

Blank when the FMC controls the speed. When changing from TO/GA to V/S, FPA, or ALT, the window automatically displays:

- the flap placard speed minus 5 knots (flaps extended)
- 250 knots (flaps up), or
- a speed value entered in the IAS/MACH window after TO/GA was pushed.

The display range is:

- 100 – 399 KIAS
- .40 – .95 Mach.

The selected speed is displayed as the PFD selected speed.

Displays 200 knots when power is first applied.

During climb, automatically changes from IAS to Mach at .84 Mach.

During descent, automatically changes from Mach to IAS at 310 KIAS.

2 IAS/MACH Reference Switch

Push –

- alternately changes the IAS/MACH window between IAS and Mach displays (Mach must be 0.4 or greater to switch from IAS to Mach)
- inoperative when the IAS/MACH window is blank.

3 IAS/MACH Selector

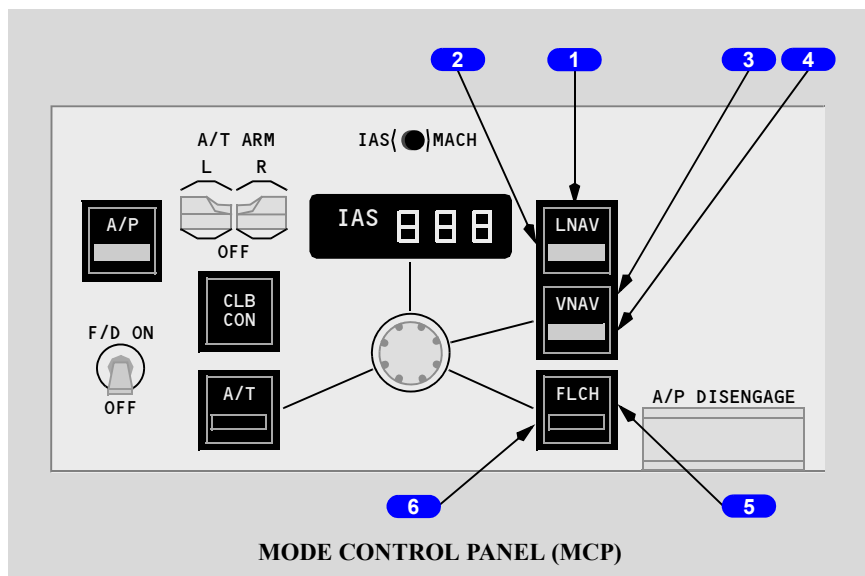
Rotate –

- Sets the speed in the IAS/MACH window and on the PFD as the selected speed.
- Inoperative when the IAS/MACH window is blank.

Push –

- With VNAV engaged, alternately opens or closes the IAS/MACH window:
 - when the window is closed, the FMC computed target speed is active and is displayed on the PFD
 - when the window is open, FMC speed-intervention is active and the IAS/MACH selector may be used to set the desired speed.

Autopilot Flight Director Roll and Pitch Controls



1 Lateral Navigation (LNNAV) Switch

Push –

- Arms, engages, or disarms LNAV as the roll mode.
- Displays LNAV in white (armed) on the PFD roll flight mode annunciator when armed. The previous roll mode remains active.
- LNAV engages if the airplane is above 50 feet radio altitude and:
 - within 2.5 NM of the active leg
 - if not within 2.5 NM of the active leg and on an intercept heading to the active leg, remains armed then engages when approaching the active leg
 - when engaged, displays LNAV in green on the PFD roll flight mode annunciator.
- Selection of LNAV with the airplane not on a heading to intercept the active leg, displays NOT ON INTERCEPT HEADING in the CDU scratch pad.
- Selection of LNAV when an active FMC route is not available displays NO ACTIVE ROUTE in the CDU scratchpad.
- LNAV maintains current heading when:
 - passing the last active route waypoint
 - passing the last waypoint prior to a route discontinuity
 - passing the last route offset waypoint

- activating the inactive route or activating an airway intercept and not within LNAV engagement criteria.

LNAV is disengaged:

- by selecting heading hold (HDG HOLD) or track hold (TRK HOLD)
- by selecting heading select (HDG SEL) or track select (TRK SEL)
- when the localizer captures
- if there is a dual FMC failure (LNAV may be re-engaged if there is an active CDU ALTN NAV route available).

LNAV is disarmed by pushing the LNAV switch a second time, or by arming LOC or APP.

2 LNAV Light

Illuminated (green) – the LNAV mode is armed or engaged.

3 Vertical Navigation (VNAV) Switch

Push –

- Arms, engages, or disarms VNAV as the pitch mode.
- Displays VNAV in white (armed) on the PFD pitch flight mode annunciator below 400 feet.
- VNAV engages 400 feet above runway elevation.
- If VNAV is selected and the FMC has insufficient data to provide VNAV guidance (such as the gross weight is invalid or there is no end-of-descent point in descent) displays PERF/VNAV UNAVAILABLE in the CDU scratchpad.
- VNAV SPD, VNAV PTH or VNAV ALT pitch mode is displayed in green (engaged) on the PFD pitch flight mode annunciator.
- In the VNAV SPD pitch mode, the AFDS commands pitch to hold target airspeed. The autothrottle operates in the THR REF, THR, IDLE or HOLD mode, as required by the phase of flight.
- In the VNAV PTH pitch mode, the AFDS commands pitch to maintain FMC target altitude or the VNAV path. The autothrottle maintains speed.
- In the VNAV ALT pitch mode, the AFDS commands pitch to maintain the MCP selected altitude when that altitude is lower than the VNAV commanded altitude in climb or higher than the VNAV commanded altitude in descent.
- If VNAV is selected and VNAV commands a descent with the MCP altitude window above the current airplane altitude, the autopilot maintains the altitude at which VNAV was selected. When on an instrument approach using VNAV, selecting the missed approach altitude does not interfere with the VNAV descent.

- If VNAV is selected and VNAV commands a climb with the MCP altitude window below the current airplane altitude, the autopilot maintains the altitude at which VNAV is selected.
- With the VNAV ALT pitch mode engaged, the autothrottle operates in the speed (SPD) mode.
- With the VNAV PTH pitch mode engaged, the autothrottle operates in the following modes:
 - for climb or cruise – operates in the speed (SPD) mode
 - for descent – operates in the IDLE, HOLD, or speed (SPD) mode.
- VNAV pitch guidance is available with one engine inoperative.

VNAV is disengaged:

- by engaging TO/GA, FLCH SPD, V/S, FPA, ALT or G/S pitch mode
- if there is a dual FMC failure.

VNAV is disarmed by:

- pushing the VNAV switch a second time, or
- arming APP.

4 VNAV Light

Illuminated (green) – the VNAV mode is armed or engaged.

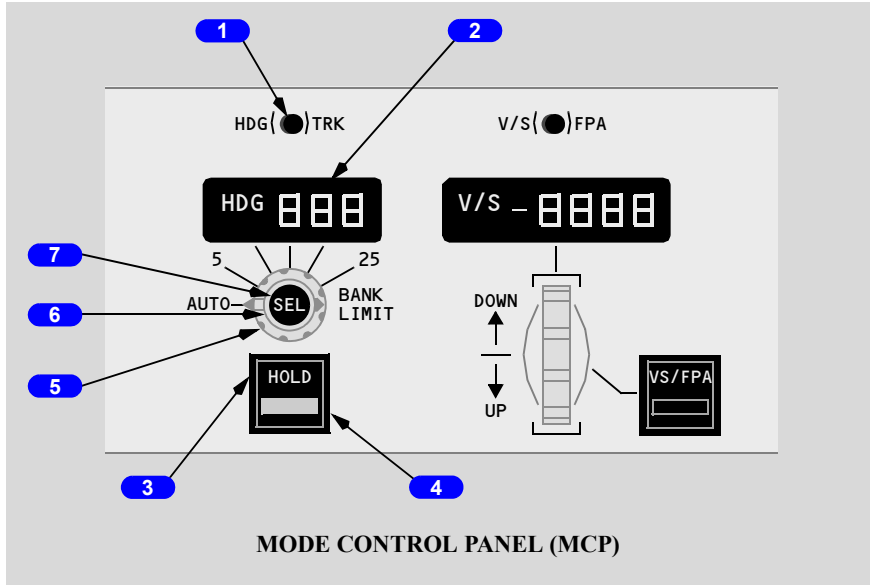
5 Flight Level Change (FLCH) Switch

Push –

- Selects FLCH SPD pitch mode.
- FLCH SPD pitch mode displays in green (active) on PFD flight mode annunciator.
- When IAS/MACH window blank, it opens to the FMC target speed, if valid. If not valid, the IAS/MACH window opens to the current speed.
- When IAS/MACH window open, it displays command speed.
- When changing from TO/GA to FLCH, IAS/MACH window displays highest value of current speed or selected speed.
- AFDS pitch holds selected speed. When selected altitude captured, pitch flight mode annunciator changes to ALT.
- A/T operates in THR. When thrust retarded to idle, HOLD mode displays in descent. When selected altitude captured, A/T mode changes to SPD.
- A/T advances or retards thrust levers to provide 500 FPM vertical speed for each 1000 feet altitude change requested; that is, a two minute climb or descent.
- With a higher altitude set in the altitude window, reference thrust limit changes to CLB when CRZ displayed or to CON with an engine inoperative.

6 Flight Level Change Light

Illuminated (green) – the flight level change mode is engaged.

Autopilot Flight Director Heading, Track, and Bank Angle Controls**1 Heading/Track (HDG/TRK) Reference Switch**

Push – alternately changes the heading/track window, PFD, and ND selected heading/track references between heading and track. Also changes the PFD roll flight mode annunciator, if the HDG or TRK mode is engaged.

2 Heading/Track Window

Displays the selected heading or track.

The selected heading or track is displayed on the PFD and ND.

If approach is armed, the numbers in the MCP heading/track window automatically change to the selected ILS front course at LOC capture.

Displays 360 degrees when power is first applied.

3 Heading/Track Hold (HOLD) Switch

Push –

- selects heading hold (HDG HOLD) or track hold (TRK HOLD) as the roll mode
- displays HDG HOLD or TRK HOLD on the PFD roll flight mode annunciator
- the AFDS commands wings level and holds the heading or track established when wings level is established.

4 Heading/Track Hold Light

Illuminated (green) – the heading/track HOLD mode is engaged.

5 BANK LIMIT Selector (outer)

Rotate – sets the AFDS commanded bank limit when in the heading select (HDG SEL) or track select (TRK SEL) roll mode as follows:

- AUTO – varies between 15 – 25 degrees, depending on TAS
- 5, 10, 15, 20 or 25 – the selected value is the maximum, regardless of airspeed.

6 Heading/Track Selector (middle)

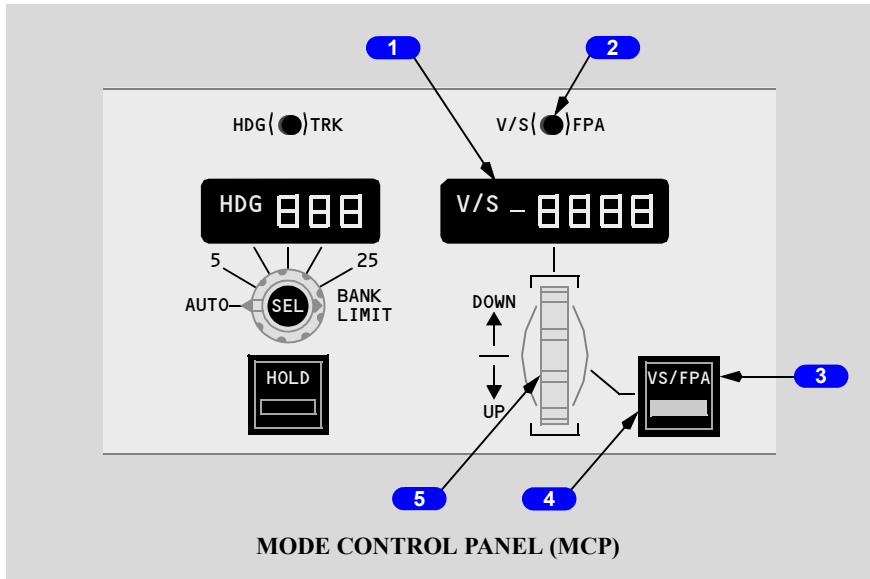
Rotate – sets heading or track in the heading/track window and on the PFDs and NDs.

7 Heading/Track Select (SEL) Switch (inner)

Push –

- selects heading select (HDG SEL) or track select (TRK SEL) as the roll mode
- displays HDG SEL or TRK SEL on the PFD roll flight mode annunciator
- the AFDS controls roll to fly the selected heading or track
- bank is limited by the bank limit selector.

Autopilot Flight Director Vertical Speed (V/S) and Flight Path Angle (FPA) Controls



1 Vertical Speed/Flight Path Angle (V/S – FPA) Window

Displays the selected vertical speed in 100 fpm increments or the selected flight path angle in 0.1 degree increments.

The display range is:

- V/S: -8000 to +6000 fpm
- FPA: -9.9 to +9.9 degrees.

Blank when the vertical speed (V/S) or flight path angle (FPA) pitch mode is not engaged; display state can be pre-selected by pushing the V/S - FPA Reference Switch.

The selected vertical speed is displayed on the PFD vertical speed indication.

The selected flight path angle is displayed on the PFD attitude indicator.

2 V/S – FPA Reference Switch

Push – alternately changes the vertical speed/flight path angle window and PFD references between vertical speed and flight path angle. Also changes the PFD pitch flight mode annunciator, if the V/S or FPA mode is engaged.

3 V/S – FPA Switch

Push –

- Engages vertical speed (V/S) or flight path angle (FPA) as the pitch mode.
- Displays V/S or FPA on the PFD pitch flight mode annunciator.
- Displays the current vertical speed or flight path angle in the vertical speed/flight path angle window.
- When the selected altitude is reached, the pitch mode changes to altitude (ALT).
- AFDS commands pitch to maintain the vertical speed or flight path angle displayed in the vertical speed/flight path angle window.
- If vertical speed or flight path angle is selected while in FLCH or VNAV, the autothrottle activates in speed (SPD) mode, if armed.

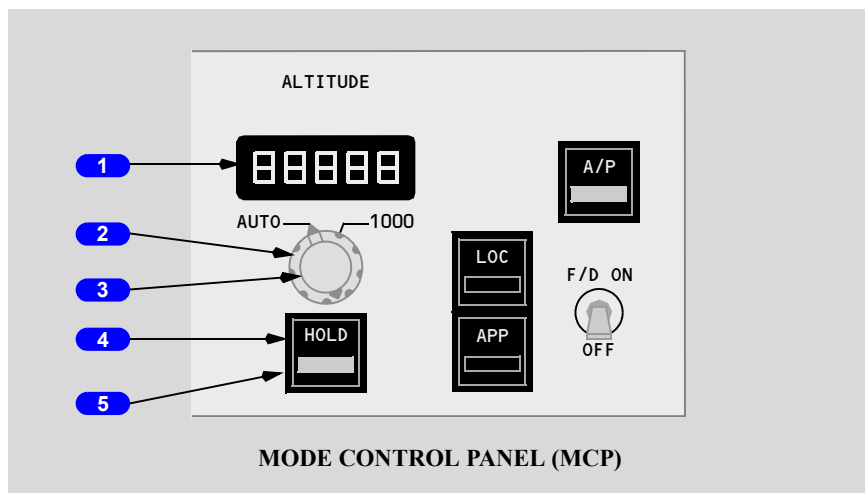
4 V/S – FPA Light

Illuminated (green) – the vertical speed/flight path angle mode is engaged.

5 V/S – FPA Selector

UP or DOWN – sets the vertical speed or flight path angle in the vertical speed/flight path angle window and on the PFDs.

Autopilot Flight Director Altitude Controls



1 Altitude Window

Displays the selected altitude.

The displayed altitude is the reference altitude for altitude alerting and level off.

The altitude range is 0 to 50,000 feet.

Displays 10,000 feet when power is first applied.

Displayed altitude transmitted to ATC when Eurocontrol-compliant transponder installed.

2 Altitude Increment Selector (outer)

AUTO –

- the altitude selector changes in 100 foot increments
- displays the selected BARO minimum as the selector passes through that altitude. If the BARO minimum is not a 10 foot increment, displays the next highest 10 foot increment.

1000 – the altitude selector changes in 1,000 foot increments.

3 Altitude Selector (inner)

Rotate – sets the altitude in the altitude window and on the PFD altitude indication display.

Push –

- During climb or descent with altitude constraints, each push deletes the next waypoint constraint between the airplane altitude and the altitude window.
- During climb with no altitude constraints, and the altitude window set above the FMC cruise altitude, the cruise altitude is changed to the altitude window value.
- During cruise:
 - with the altitude window set above or below FMC cruise altitude, the FMC cruise altitude resets to the altitude window altitude
 - if in VNAV PTH or VNAV ALT pitch mode, the airplane begins a climb or descent toward the altitude window altitude
 - within 50 NM of the top-of-descent (T/D) point, with the altitude window set below cruise altitude, the airplane initiates the descend now (DES NOW) feature.

4 Altitude HOLD Switch

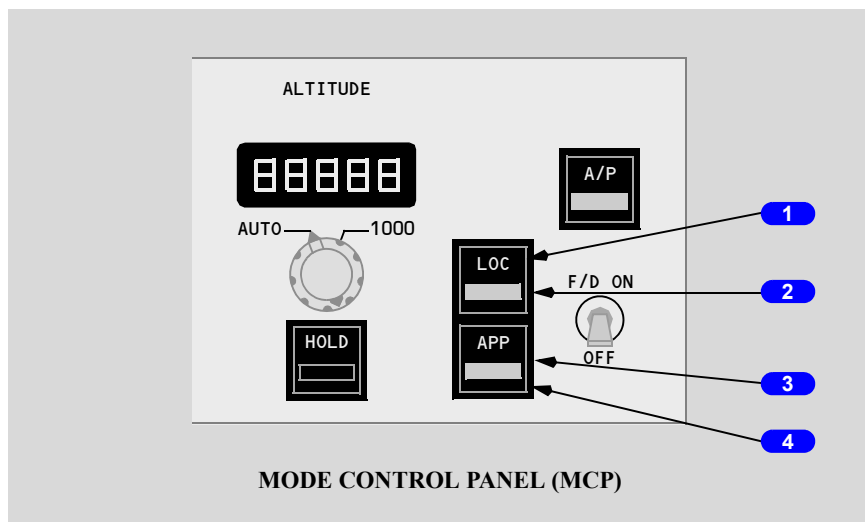
Push –

- engages altitude (ALT) as the pitch mode
- ALT is displayed on the PFD pitch flight mode annunciator
- the AFDS commands pitch to maintain the altitude when the switch was pushed.

5 Altitude Hold Light

Illuminated (green) – the altitude hold mode is engaged.

Autopilot Flight Director Approach Mode Controls



1 Localizer (LOC) Switch

Push –

- arms, disarms, engages, or disengages localizer (LOC) as the roll mode
- displays LOC in white (armed) on the PFD roll flight mode annunciator before localizer capture
- displays LOC in green (engaged) on the PFD roll flight mode annunciator after localizer capture
- arms the AFDS to capture and track inbound on the front course
- the capture point varies based on range and intercept angle
- localizer capture can occur when an intercept track angle is within 120 degrees of the localizer course.

The localizer mode can be disarmed before localizer capture by:

- pushing the localizer switch a second time, or
- selecting LNAV.

The localizer mode can be disengaged after localizer capture by:

- selecting a roll mode other than LNAV,
- pushing a TO/GA switch,
- disengaging the autopilot and turning both flight director switches off, or
- pushing the localizer switch a second time above 1,500 feet radio altitude (reverts to the default roll mode).

2 Localizer Light

Illuminated (green) – the localizer mode is armed or engaged.

3 Approach (APP) Switch

Push –

- arms, disarms, engages, or disengages localizer (LOC) as the roll mode and glideslope (G/S) as the pitch mode
- displays LOC and G/S in white (armed) on the PFD roll and pitch flight mode annunciators prior to localizer and glideslope capture
- displays LOC and G/S in green (engaged) on the PFD roll and pitch flight mode annunciators after each one is captured
- the AFDS captures and tracks the localizer in the localizer (LOC) mode and captures the glideslope in the glideslope (G/S) mode upon interception
- localizer captures when the intercept track angle is within 120 degrees of the localizer course
- glideslope captures when the intercept track angle is within 80 degrees of the localizer course.

[\[Option – GS capture not inhibited before LOC capture\]](#)

Glideslope can capture before localizer capture.

[\[Option – GS capture inhibited before LOC capture\]](#)

Glideslope capture is inhibited before localizer capture.

The approach mode can be disarmed with localizer and glideslope armed by selecting APP, LOC, LNAV, or VNAV.

The approach mode disengages:

- with localizer captured and glideslope armed, by selecting heading select (HDG SEL) or heading hold (HDG HOLD)

[\[Option – GS capture not inhibited before LOC capture\]](#)

- with glideslope captured and localizer armed, by selecting any other pitch mode except VNAV
- after localizer and/or glideslope are captured, by engaging TO/GA mode, or by disengaging the autopilot and turning both flight director switches off
- after localizer and/or glideslope are captured, by pushing the approach switch a second time above 1,500 feet radio altitude (AFDS reverts to default roll and pitch modes).

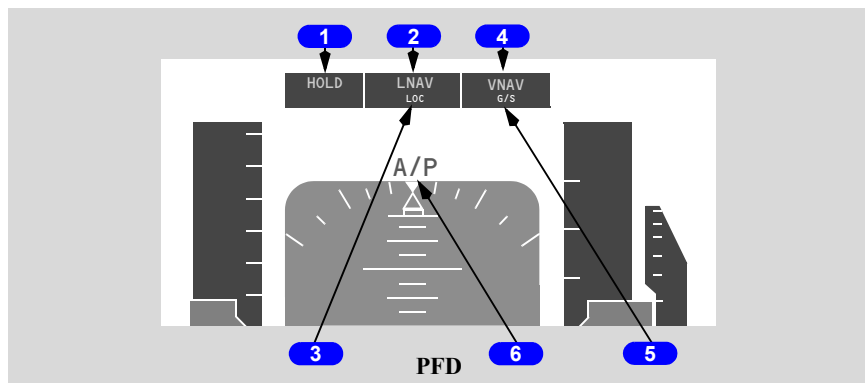
4 Approach Light

Illuminated (green) – the approach modes (LOC and G/S) are armed or engaged.

PFD Flight Mode Annunciations (FMAs)

Note: When first engaged/activated, AFDS/autothrottle mode changes are emphasized for 10 seconds by a green box drawn around the mode. A change to the AFDS mode NO AUTOLAND is emphasized by an amber box.

Note: An amber horizontal line is drawn through the appropriate ENGAGED pitch or roll mode when a flight mode fault is detected.



1 Autothrottle Modes (Active)

Displayed (green) –

- THR
- THR REF
- HOLD
- IDLE
- SPD

2 AFDS Roll Modes (Engaged)

Displayed (green) –

- HDG HOLD
- HDG SEL
- LNAV
- LOC
- ROLLOUT
- TO/GA
- TRK SEL
- TRK HOLD
- ATT

3 AFDS Roll Modes (Armed)

Displayed (white) –

- LOC
- ROLLOUT
- LNAV

4 AFDS Pitch Modes (Engaged)

Displayed (green) –

- TO/GA
- ALT
- V/S
- VNAV PTH
- VNAV SPD
- VNAV ALT
- G/S
- FLARE
- FLCH SPD
- FPA

5 AFDS Pitch Modes (Armed)

Displayed (white) –

- G/S
- FLARE
- VNAV

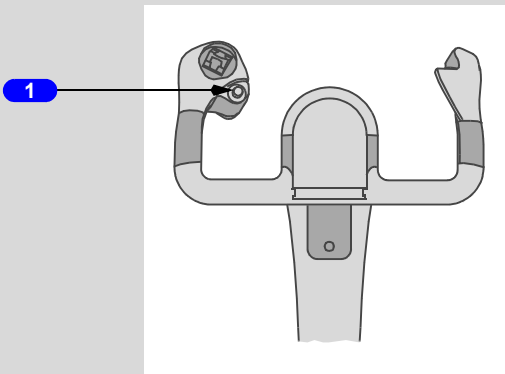
6 AFDS (Engaged)

Displayed (green) –

- FLT DIR
- A/P
- LAND 3

Displayed (green with white triangles) – ▷LAND2◁

Displayed (amber) – NO AUTOLAND.

Autopilot Disconnect Switch

CONTROL WHEEL

1 Autopilot Disconnect Switches

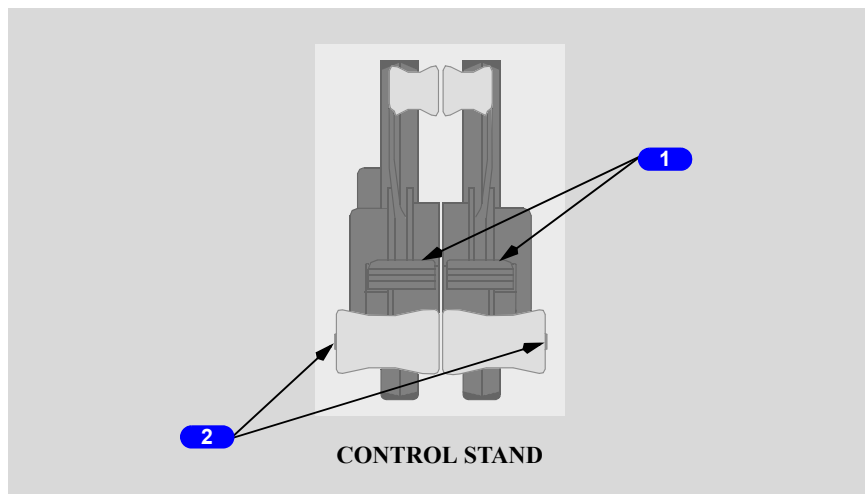
First push (either switch) –

- disconnects the autopilot
- the master warning lights illuminate
- displays the EICAS warning message AUTOPILOT DISC
- sounds an aural warning
- if the autopilot automatically disconnects, resets the master warning lights, EICAS warning message, and the aural warning.

Second push – resets:

- the master warning lights
- EICAS warning message
- the aural warning.

TO/GA and Autothrottle Disconnect Switches



1 Takeoff/Go-around (TO/GA) Switches

On the ground:

Push –

- below 50 knots and flaps out of up, activates autothrottle in THR REF mode at thrust limit selected on THRUST LIMIT page. If not pushed below 50 knots, autothrottle operation is inhibited until reaching 400 feet altitude
- pushing either switch above 80 knots disarms LNAV and VNAV

In flight:

Push (after lift-off with takeoff thrust limit displayed) –

- removes takeoff and climb derates and assumed temperature thrust reduction
- A/T in HOLD, activates A/T in THR REF mode
- disarms AFDS modes
- between 50 feet and 400 feet, selects TO/GA roll mode
- above 400 feet, selects TO/GA roll and pitch modes

Push (on approach with flaps out of up or glideslope captured) –

- activates autothrottle in THR mode with GA thrust limit displayed
- disarms AFDS modes
- selects TO/GA roll and pitch modes
- arms or engages LNAV if an LNAV path is available
- second push – activates autothrottle in THR REF mode

2 Autothrottle Disconnect Switches

Push (either switch) –

- disconnects the autothrottle (both left and right)
- illuminates the master caution lights
- displays the EICAS message AUTOTHROTTLE DISC
- if the autothrottle automatically disconnects, resets the master caution lights and EICAS message.

Second push –

- resets the master caution lights and EICAS message
- the autothrottle remains armed.

Intentionally
Blank

Automatic Flight System Description

Chapter 4 Section 20

Introduction

The automatic flight control system consists of the autopilot flight director system (AFDS) and the autothrottle system. Both the AFDS and the autothrottle are controlled using the mode control panel (MCP) and the FMC.

Normally, the AFDS and autothrottle are controlled automatically by the FMC to perform climb, cruise, descent, and approach flight path guidance.

Autopilot Flight Director System

The AFDS consists of three autopilot flight director computers (AFDCs) and the MCP.

The MCP provides control of the autopilot, flight director, altitude alert, and autothrottle systems. The MCP is used to select and activate AFDS modes, and establish altitudes, speeds, and climb/descent profiles.

The AFDCs provide control of the flight directors, and autopilot. Flight director information is displayed on the primary flight displays (PFDs). The AFDS does not have direct control of the flight control surfaces. The autopilot controls the elevators, ailerons, flaperons, and spoilers through the fly-by-wire flight control system. Autopilot rudder commands are added only during an autopilot approach and landing. The autopilot controls nose wheel steering during rollout after an automatic landing.

MCP Mode Selection

MCP mode switches are used to select automatic flight control and flight director modes. A light in the lower half of each switch illuminates to indicate that the mode is armed or engaged. Mode engagement is indicated by the PFD roll and pitch flight mode annunciations. Autothrottle modes are discussed later in this section.

Most modes engage with a single push. These modes include:

- flight level change (FLCH SPD)
- heading hold (HDG HOLD)
- track hold (TRK HOLD)
- heading select (HDG SEL)
- track select (TRK SEL)
- vertical speed (V/S)
- flight path angle (FPA)
- altitude hold (ALT).

Other modes arm or engage with a single push. These modes are:

- lateral navigation (LNAV)
- vertical navigation (VNAV)
- localizer (LOC)
- approach (APP).

All modes except APP can be disengaged by selecting another mode. All modes can be disengaged by disconnecting the autopilot and turning both flight directors off. After localizer and glideslope capture, the localizer and glideslope modes can only be disengaged by disconnecting the autopilot and turning both flight directors off, engaging the go-around mode, or if above 1,500 feet radio altitude, by reselecting APP (roll and pitch will revert to default modes). The VNAV, LNAV, LOC and APP modes can be disarmed by pushing the mode switch a second time.

Desired target values can be selected on the MCP for:

- airspeed
- Mach
- heading
- track
- vertical speed
- flight path angle
- altitude.

All of these parameters except vertical speed and flight path angle can be preselected prior to autopilot and/or flight director engagement.

Autopilot Engagement

The autopilot is engaged by pushing either of the two MCP autopilot engage switches.

Autopilot Disengagement

Normal autopilot disengagement is through either control wheel autopilot disconnect switch. The autopilots can also be disengaged by:

- the MCP autopilot disengage bar, or
- overriding with the control column, control wheel, or rudder pedals (pedals will only disengage the autopilots with LAND 2 or LAND 3 annunciated).

When an override force sufficient to move the control column, control wheel, or rudder pedals (LAND 2 or LAND 3 annunciated) is applied, the fly-by-wire flight control system will detect a difference between the cockpit controls and its own estimate of the expected positions, and will force a disconnect of the autopilot. After the autopilot is disconnected, the control system will transition the control surface commands from those of the autopilot to those of the flight crew.

An automatic autopilot disconnect occurs for some failures detected by the autopilot. The EICAS warning message AUTOPILOT DISC is displayed if the autopilot is manually or automatically disconnected. Depending upon the system failure, it may be possible to re-engage an autopilot by pushing the autopilot engage switch.

Autopilot and Flight Director Mode Degradations

Autopilot

The autopilot system can detect the degradation of a specific autopilot mode. When an engaged mode degrades, the autopilot remains engaged in an attitude stabilizing mode based on inertial data. If the degradation persists, the condition is annunciated on the PFD by an amber line drawn through the affected flight mode annunciation. If the degradation continues, the EICAS caution message AUTOPILOT is displayed to indicate the autopilot is operating in a degraded mode. When the degradation is no longer present the annunciations clear, the autopilot resumes using the mode, and a green box is drawn around the affected flight mode annunciation on the PFD for 10 seconds.

Flight Director

When a specific flight director mode degrades, the flight director provides an attitude stabilizing command based on inertial data. If the degradation persists, the condition is annunciated by removal of the affected (pitch or roll) flight director bar. When the degradation is no longer present the flight director commands immediately return to view.

ILS Signal Interference Monitor

The autopilot flight director system (AFDS) can detect significant ILS signal interference due to service vehicles or aircraft. If localizer or glideslope signal interference is detected, the autopilot disregards the ILS signal and remains engaged in an attitude stabilizing mode based on inertial data. Most ILS signal interferences last only a short period of time, so there is no annunciation other than erratic movement of the ILS raw data during the time the interference is present. If the condition persists, the annunciations described above for Autopilot and Flight Director Mode Degradation are provided.

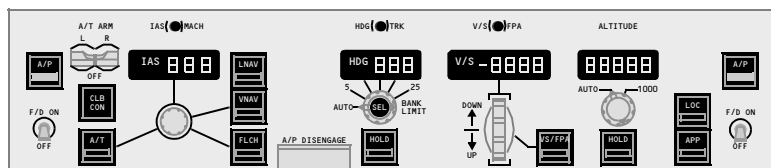
Flight Director Display

The flight director steering indications are normally displayed any time the related flight director switch is ON.

The steering indications are also displayed when the related flight director switch is OFF and a TO/GA switch is pushed, if airspeed is greater than 80 knots and the flaps are not retracted. In this case, the flight director display can be removed by cycling the respective flight director switch on and then off.

A flight director mode failure, in either pitch or roll, causes the respective steering bars to disappear. The stall and overspeed protection functions will also cause the pitch flight director bar to disappear.

Autopilot Flight Director System Schematic



AFDS

Fly-by-Wire
Flight Control
System
(Chapter 9)

AFDS Status Annunciation

The following AFDS status annunciations are displayed just above the PFD attitude display:

- FLT DIR (the flight director is ON and the autopilots are not engaged)
- A/P (the autopilots are engaged)
- LAND 3 (three autopilots are engaged and operating normally for an automatic landing)

- LAND 2 (AFDS redundancy is reduced; in some cases, only two autopilots are available)
- NO AUTOLAND (the AFDS is unable to make an automatic landing).

With a LAND 3 indication, the autopilot system level of redundancy is such that a single fault cannot prevent the autopilot system from making an automatic landing (fail operational).

With a LAND 2 indication, the level of redundancy is such that a single fault cannot cause a significant deviation from the flight path (fail passive).

An EICAS message is displayed for any fault which limits the capability of the automatic landing system. Aural alerts for EICAS messages not affecting safety of flight are inhibited until after touchdown. Changes in autoland status below 200 feet, other than a transition to NO AUTOLAND status, are inhibited.

AFDS Flight Mode Annunciations

The flight mode annunciations are displayed just above the PFD AFDS status annunciations. The mode annunciations, from left to right, are:

- autothrottle
- roll
- pitch.

Engaged or captured modes are shown at the top of the flight mode annunciator boxes in large green letters. Armed modes (except for TO/GA in the air) are shown in smaller white letters at the bottom of the flight mode annunciator boxes. Degradations of a specific mode while the autopilot is engaged are annunciated by an amber line drawn through the mode annunciations. A green box is drawn around the mode annunciation for 10 seconds when a mode first becomes active, and when the amber line through a degraded mode is removed.

Autothrottle Modes

The autothrottle modes are:

- THR – The autothrottle applies thrust to maintain the vertical speed required by the pitch mode.
- THR REF – Thrust is set to the selected thrust limit displayed on EICAS.
- IDLE – Displayed while the autothrottle moves the thrust levers to idle; IDLE mode is followed by HOLD mode.
- HOLD – The thrust lever autothrottle servos are inhibited. The pilot can set the thrust levers manually.
- SPD – The autothrottle maintains the selected speed displayed on the PFD. Speed can be set by the MCP IAS/MACH selector or by the FMC, as shown on the CDU CLIMB, CRUISE, or DESCENT page. The autothrottle will not exceed the operating speed limits or the thrust limits displayed on the EICAS.

Roll Modes

The roll modes are:

LNAV –

- LNAV (armed) – LNAV is armed to engage when parameters are met.
- LNAV (engaged) – LNAV engages if above 50 feet, and within 2 1/2 NM of the active route leg. The AFDS follows the active leg displayed on the ND.

HDG –

- HDG SEL (engaged) – The airplane is turning to, or is on the heading selected in the MCP heading/track window.
- HDG HOLD (engaged) – The AFDS holds the present heading. If turning, the AFDS holds the heading reached after rolling wings level.

TRK –

- TRK SEL (engaged) – The airplane is turning to, or is on the track selected in the MCP heading/track window.
- TRK HOLD (engaged) – The AFDS holds the present track. If turning, the AFDS holds the track reached after rolling wings level.

[Option – ATT Hold Engage]

ATT – (engaged) – When the autopilot is first engaged or the flight director is first turned on in flight, the AFDS holds a bank angle between 5 and 30 degrees and will not roll to wings level. If the bank angle is less than 5 degrees, the AFDS returns to wings level (HDG HOLD or TRK HOLD). If the bank angle is greater than 30 degrees, the AFDS returns to 30 degrees of bank

LOC –

- LOC (armed) – The AFDS captures the localizer when within range and within 120 degrees of the localizer track.
- LOC (engaged) – The AFDS follows the selected localizer course.

TO/GA –

- On the ground, TO/GA annunciates by positioning either flight director switch ON when both flight directors are OFF, or by pushing either TO/GA switch with airspeed greater than 80 KTS. TO/GA roll guidance becomes active at lift-off.
- In flight, TO/GA is armed when flaps are out of up or glideslope is captured. There is no flight mode annunciation for TO/GA armed. TO/GA is activated in flight by pushing a TO/GA switch. The roll steering indication provides guidance to maintain the ground track present at mode engagement.

ROLLOUT –

- ROLLOUT (armed) – Displayed below 1500 feet radio altitude and engages below 2 feet.
- ROLLOUT (engaged) – After touchdown, the AFDS uses rudder and nosewheel steering to keep the airplane on the localizer centerline.

Pitch Modes

The pitch modes are:

TO/GA –

On the ground, TO/GA annunciates by positioning either flight director switch ON when both flight directors are OFF, or by pushing either TO/GA switch with airspeed greater than 80 knots. The flight director PFD pitch bar indicates an initial pitch of eight degrees up. TO/GA pitch guidance becomes active at lift-off.

After lift-off, the AFDS commands a pitch attitude to maintain:

- a target speed of V2 plus 15 knots or the airspeed at rotation (pitch attitude greater than two degrees) plus 15 knots, whichever is greater.
- if current airspeed exceeds the target speed for 5 seconds, the target speed is reset to the lesser of the current airspeed or V2 plus 25 knots.
- the IAS/MACH window speed if the window speed is changed to a speed greater than the target speed.

Note: The AFDS uses the speed set in the IAS/MACH window prior to takeoff for V2.

In flight, TO/GA is armed when flaps are out of up or glideslope is captured.

When a go-around is initiated, the commanded speed is the MCP IAS/MACH window or current airspeed, whichever is higher, to a maximum of the IAS/MACH window speed plus 25 knots. GA displays as the thrust limit on the primary EICAS engine display.

VNAV –

VNAV is armed by pushing the VNAV switch (the switch bar is displayed and VNAV is annunciated on the PFD pitch mode annunciator in small white characters below the current pitch mode).

VNAV engages above 400 feet after takeoff, if armed. VNAV engages in the appropriate VNAV mode as required to maintain the current flight path:

- VNAV SPD (engaged) – The AFDS maintains the FMC speed displayed on the PFD airspeed indicator and/or the CDU CLIMB or DESCENT pages. If speed intervention is selected, the MCP IAS/MACH selector is used to manually select the speed.
- VNAV PTH (engaged) – The AFDS maintains FMC altitude or descent path with pitch commands. If the MCP altitude window is set to the current cruise altitude as the airplane approaches the top of descent, the CDU scratchpad message RESET MCP ALT displays.
- VNAV ALT (engaged) – When a conflict occurs between the VNAV profile and the MCP altitude, the airplane levels and the pitch flight mode annunciation becomes VNAV ALT. VNAV ALT maintains altitude. To continue the climb or descent, change the MCP altitude and push the altitude selector or change the pitch mode.
- If an early descent is desired, FLCH, V/S, or FPA may be selected to descend below the VNAV descent path. If, during the decent, VNAV is armed and the airplane descent path subsequently intercepts the VNAV descent path, VNAV engages in VNAV PTH.

V/S (engaged) – Pushing the MCP VS/FPA switch, opens the vertical speed window to display the current vertical speed. Pitch commands maintain the rate of climb or descent selected in the VS/FPA window.

FPA (engaged) – Pushing the MCP VS/FPA switch opens the flight path angle window to display the current flight path angle. Pitch commands maintain the flight path angle selected in the VS/FPA window.

FLCH SPD (engaged) – Pushing the MCP FLCH switch opens IAS/MACH window (if blanked). Pitch commands maintain IAS/MACH window airspeed or Mach.

ALT (engaged) – Altitude hold mode is engaged by:

- pushing the MCP altitude HOLD switch, or
- capturing the selected altitude from a V/S, FPA, or FLCH climb or descent.

G/S (engaged) – The AFDS follows the ILS glideslope.

FLARE (armed) – During an autoland, FLARE is displayed below 1500 feet RA.

FLARE (engaged) – During an autoland, flare engages between 60 and 40 feet radio altitude. FLARE accomplishes the autoland flare maneuver so the AFDS can transition to the ROLLOUT mode.

Autothrottle System

The autothrottle system provides automatic thrust control from takeoff through landing.

Autothrottle operation is controlled from the MCP and the CDUs. The MCP provides mode and speed selection. The CDU provides FMC thrust reference mode selection. When the VNAV mode is selected, the FMC selects the autothrottle modes and target thrust values. Refer to Chapter 11, Flight Management, Navigation, for FMS and CDU operation.

The autothrottle can be operated without using the flight director or the autopilot. In this condition, the autothrottle operates in either the THR REF, SPD, HOLD or IDLE modes.

When the autothrottle is used during a manual landing, thrust reduces to IDLE at 25 feet radio altitude when the flight director is off or the pitch mode is V/S, FPA, G/S, or any VNAV mode (VNAV SPD, VNAV PTH, or VNAV ALT). The autothrottle does not automatically retard if the pitch mode is TO/GA or FLCH.

With the autothrottle armed, the autothrottle automatically activates if:

- no autopilot or flight director active, or
- an autopilot or flight director is in VNAV XXX, FPA, ALT, V/S, or G/S,
and:
 - speed less than an FMC calculated value for one second
 - thrust below reference thrust
 - airplane altitude above 100 feet RA on approach, or airplane barometric altitude 400 feet above airport on takeoff.

Note: During a descent in VNAV SPD, the autothrottle may activate in HOLD mode and will not support stall protection.

The EICAS advisory message AUTOTHROTTLE L or R is displayed when the respective autothrottle servo fails. If the autothrottle is active and only one autothrottle is armed, the PFD autothrottle flight mode annunciation displays L or R preceding the mode. For example, L SPD indicates only the left autothrottle is active in speed mode.

Autothrottle Thrust Lever Operation

The autothrottle system moves either or both thrust levers to provide speed or thrust control, depending on the active mode.

The thrust levers can be manually positioned without disconnecting the autothrottle. After manual positioning, the autothrottle system repositions the thrust levers to comply with the active mode. The autothrottle system does not reposition the thrust levers while in HOLD mode.

Autothrottle Disconnect

The autothrottle system can be disconnected manually by pushing either thrust lever autothrottle disconnect switch, except during conditions that cause the autothrottle to automatically activate. The autothrottle can also be disconnected manually by positioning both A/T ARM switches to OFF, or individually by positioning the left or right A/T ARM switch to OFF. Positioning one or both A/T ARM switches to OFF prevents activation of all autothrottle modes for the affected autothrottle.

Autothrottle disconnect occurs automatically:

- if a fault in the active autothrottle mode is detected
- when either reverse thrust lever is raised to reverse idle
- if the thrust levers are overridden during a manual landing, after the autothrottle has begun to retard the thrust levers to idle
- when both engines are shut down.

The EICAS caution message AUTOTHROTTLE DISC is displayed and an aural alert sounds when the autothrottle is manually or automatically disconnected. The EICAS caution message and aural alert are inhibited if the disconnect occurs because of reverse thrust.

Automatic Flight Operations

Automatic Flight Takeoff and Climb

Takeoff is a flight director only function of the takeoff/go-around (TO/GA) mode. The autopilot may be engaged after takeoff.

During preflight:

- With the autopilot disengaged and both flight director switches OFF, engagement of TO/GA roll and pitch mode occurs when the first flight director switch is positioned ON.
- The PFD displays FLT DIR as the AFDS status and TO/GA as the pitch and roll flight mode annunciations.
- The pitch command is a fixed attitude (about eight degrees up).
- The roll command is wings level.

During takeoff prior to lift-off:

- With speed less than 50 KIAS, pushing a TO/GA switch activates the autothrottle in the thrust reference (THR REF) mode. The thrust levers advance to the selected thrust limit. If the autothrottle is not active by 50 knots, it cannot be activated until above 400 feet.
- At 80 knots, the autothrottle mode annunciation changes to HOLD.

- With speed greater than 80 knots, pushing a TO/GA switch disarms LNAV and VNAV.
- During takeoff, the FMC records the barometric altitude as the airplane accelerates through 100 knots. This altitude is used to engage VNAV, enable autothrottle activation (if not active), command acceleration for flap retraction, and set climb thrust if an altitude has been selected. Radio altitude is used for engagement of LNAV.

At lift-off:

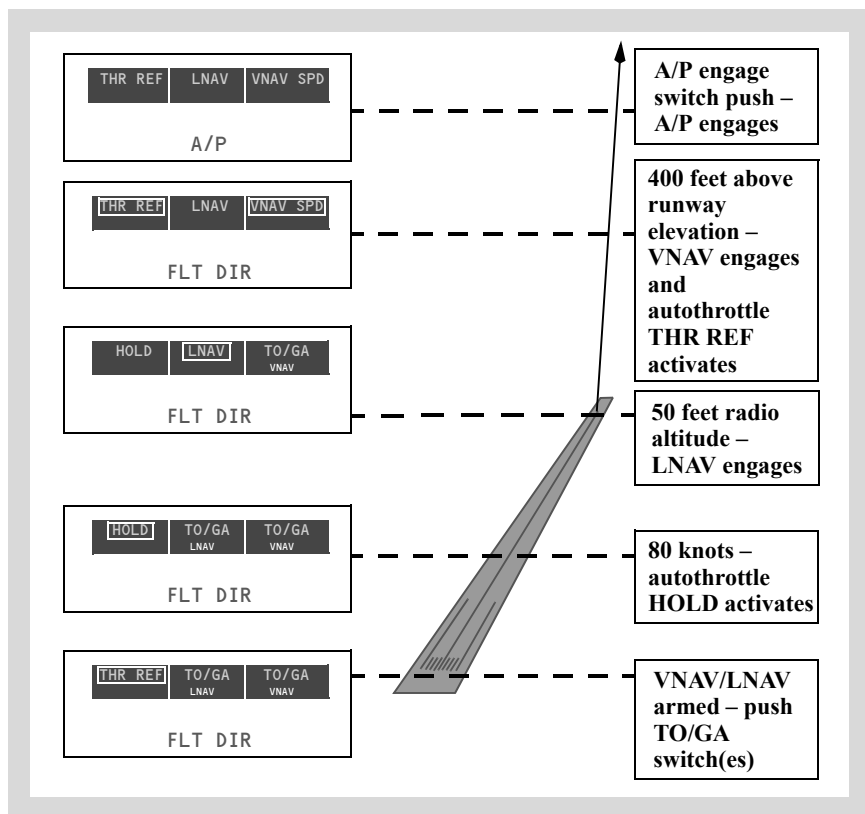
- The pitch command target speed is $V_2 + 15$. If current airspeed remains above the target speed for 5 seconds, the target airspeed is reset to current airspeed (limited to a maximum of $V_2 + 25$).
- If an engine failure occurs on the ground, the pitch command target speed at lift-off is V_2 or airspeed at lift-off, whichever is greater.
- The roll command maintains ground track.

After lift-off:

- If an engine failure occurs, the pitch command target speed is:
 - V_2 , if airspeed is below V_2
 - existing speed, if airspeed is between V_2 and $V_2 + 15$
 - $V_2 + 15$, if airspeed is above $V_2 + 15$.
- If a TO/GA switch is pushed:
 - removes takeoff and climb derates and assumed temperature thrust reduction
 - A/T in HOLD, the A/T activates in THR REF.
- At 50 feet radio altitude, LNAV engages, if armed. Roll commands bank to track the active route.
- At 400 feet above runway elevation, VNAV engages, if armed. Pitch commands the current airspeed. The autothrottle sets the selected reference thrust and annunciates THR REF.
- At acceleration height, pitch commands speed to 5 knots below takeoff flap placard speed. As flaps are retracted, pitch commands an acceleration to 5 knots below the placard speed of the commanded flap position.
- When flaps are up, pitch commands an acceleration to VNAV climb speed. VNAV climb speed is the greater of:
 - $V_{REF} + 80$ knots, or
 - speed transition associated with origin airport
- At thrust reduction point (either an altitude or a flap position), the FMC changes the thrust limit to the armed climb limit (CLB, CLB 1, or CLB 2).

The TO/GA mode is terminated by selecting any other pitch and roll mode; automatic LNAV/VNAV engage terminates TO/GA mode.

Automatic Flight Takeoff Profile



Automatic Flight En Route

The autopilot and/or the flight director can be used after takeoff to fly a lateral navigation track (LNAV) and a vertical navigation track (VNAV) provided by the FMS. Using LNAV and VNAV ensures the most economical operation.

Other roll modes available are:

- heading hold (HDG HOLD)
- heading select (HDG SEL)
- track hold (TRK HOLD)
- track select (TRK SEL).

Other pitch modes available are:

- altitude hold (ALT)
- flight level change (FLCH SPD)
- vertical speed (V/S)
- flight path angle (FPA).

Profile illustrations show the use of LNAV and VNAV.

Automatic Flight Approach and Landing

The AFDS provides autopilot guidance for ILS approaches.

[Option – GS capture not inhibited before LOC capture]

Pushing the APP switch arms localizer in roll mode and glideslope in pitch mode. Either localizer or glideslope can be captured first.

[Option – GS capture inhibited before LOC capture]

Pushing the APP switch arms localizer in roll mode and glideslope in pitch mode. Glideslope capture is inhibited until the localizer is captured.

Pushing the LOC switch arms the AFDS for localizer tracking. Descent on the localizer can be accomplished using VNAV, V/S, FLCH, or FPA pitch modes. The localizer mode cannot capture if the intercept angle exceeds 120 degrees. All other non-ILS approaches can be flown using LNAV and VNAV modes, or HDG SEL, TRK SEL, V/S, or FPA modes.

With a command speed of VREF+5 knots and landing flaps, there is sufficient wind and gust protection available with the autothrottle active. The autothrottle adjusts thrust quickly when the airspeed decreases below the command speed. The autothrottle decreases thrust slowly when the airspeed is more than the command speed. In turbulence, the result is that the thrust average is higher than necessary to keep the command speed. This causes the speed average to be more than the command speed.

Runway Alignment

Runway alignment is a submode of the approach mode. With crosswinds, the crab angle is reduced at touchdown. Runway alignment also compensates for a single engine approach.

For crosswinds requiring more than 10 degrees of crab angle, runway alignment occurs at 500 feet AGL. A sideslip of 5 degrees is established to reduce the crab angle. This configuration is maintained until touchdown. The airplane lands with the upwind wing low.

For crosswinds requiring a crab angle of between 5 and 10 degrees, an initial alignment occurs at 500 feet AGL, followed by a second alignment at 200 feet AGL. The initial alignment initiates a sideslip to reduce the crab angle to 5 degrees. This configuration is maintained to 200 feet AGL, where a second sideslip alignment increases the sideslip to further reduce the touchdown crab angle.

For crosswinds requiring a crab angle of less than 5 degrees, no runway alignment occurs until 200 feet AGL, where a sideslip is introduced to align the airplane with the runway.

If an engine fails prior to the approach, the AFDS introduces a sideslip at 1,300 feet AGL. This establishes a wings level configuration. If an engine fails during the approach, the wings level configuration is established when the engine failure is detected.

In the event of moderate or strong crosswinds from the side opposite the failed engine, no wings level sideslip is commanded, since the airplane is already banked into the wind.

Flare

The flare mode brings the airplane to a smooth automatic landing touchdown. The flare mode is not intended for single autopilot or flight director only operation.

Flare is armed when LAND 3 or LAND 2 is annunciated on the PFDs. At approximately 50 feet radio altitude, the autopilots start the flare maneuver. FLARE replaces the G/S pitch flight mode annunciation.

During flare:

- between 25 and 50 feet radio altitude, the autothrottle begins retarding the thrust levers to idle
- the PFD autothrottle annunciation changes from SPD to IDLE
- at touchdown, the FLARE annunciation is no longer displayed, and the nose is lowered to the runway.

Rollout

Rollout provides localizer centerline rollout guidance. Rollout is armed when LAND 3 or LAND 2 is annunciated on the PFDs.

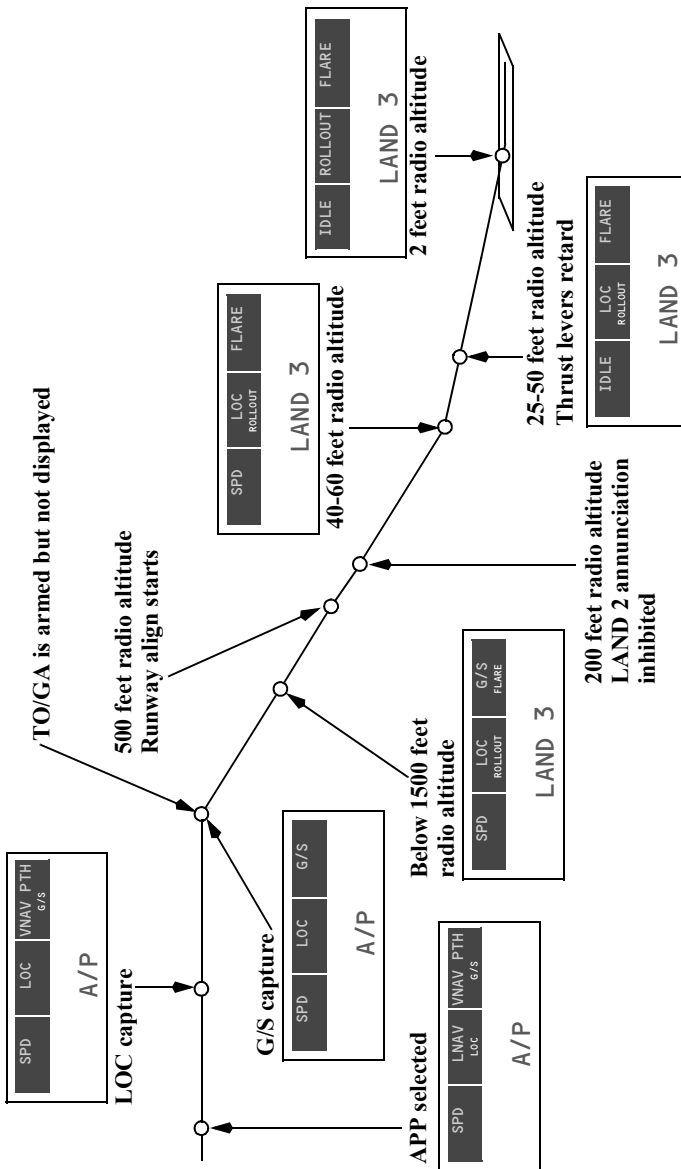
At less than two feet radio altitude, rollout engages. ROLLOUT replaces the LOC roll mode annunciation.

The autopilot controls the rudder and nose wheel steering to keep the airplane on the localizer centerline.

During rollout, the autothrottle IDLE mode remains active until the autothrottle is disconnected.

Rollout guidance continues until the autopilots are disengaged.

Automatic Flight Approach Profile



Go-Around

TO/GA is armed when flaps are out of UP or glideslope is captured. The thrust limit changes to GA when flaps are extended out of UP, flaps are extended to landing position, or glideslope is captured. The thrust limit is locked in GA when flaps are in landing position or glideslope is captured.

Pushing either TO/GA switch activates a go-around. The mode remains active even if the airplane touches down while executing the go-around.

When the flight director switches are not on, pushing either TO/GA switch displays the flight director bars.

The TO/GA switches are inhibited when on the ground and enabled again when in the air for a go-around or touch and go.

With the first push of either TO/GA switch:

- the PFDs display roll and pitch guidance to fly the go-around
- the autothrottle activates in thrust (THR) mode for a 2,000 FPM climb
- the AFDS increases pitch to hold the selected speed as thrust increases
- if current airspeed remains above the target speed for 5 seconds, the target airspeed is reset to current airspeed, (to a maximum of the IAS/MACH window speed plus 25 knots).

[LNAV auto-engage option - requires AIMS 05]

- if an LNAV path is available, LNAV automatically arms and engages:
 - above 50 feet radio altitude when autopilot is not engaged, or
 - above 200 feet radio altitude when autopilot is engaged.

Note: During go-around from a LAND 2 or LAND 3 approach, automatic LNAV engagement causes disconnect of autopilot rudder control. If executing an engine out missed approach with TAC inoperative, manual rudder control may be required to prevent large roll and yaw excursions.

With the second push of either TO/GA switch:

- the autothrottle activates in the thrust reference (THR REF) mode for full go-around thrust.

TO/GA level-off:

- at the selected altitude, the AFDS pitch mode changes to altitude hold (ALT)
- if altitude is captured, or if V/S or FPA is engaged, MCP speed is automatically set to:
 - the flap placard speed minus 5 knots
 - 250 knots if flaps are up, or
 - a speed value entered in the IAS/Mach window after TO/GA was pushed

[no LNAV auto-engage]

- go-around remains the engaged roll mode until another mode is selected.

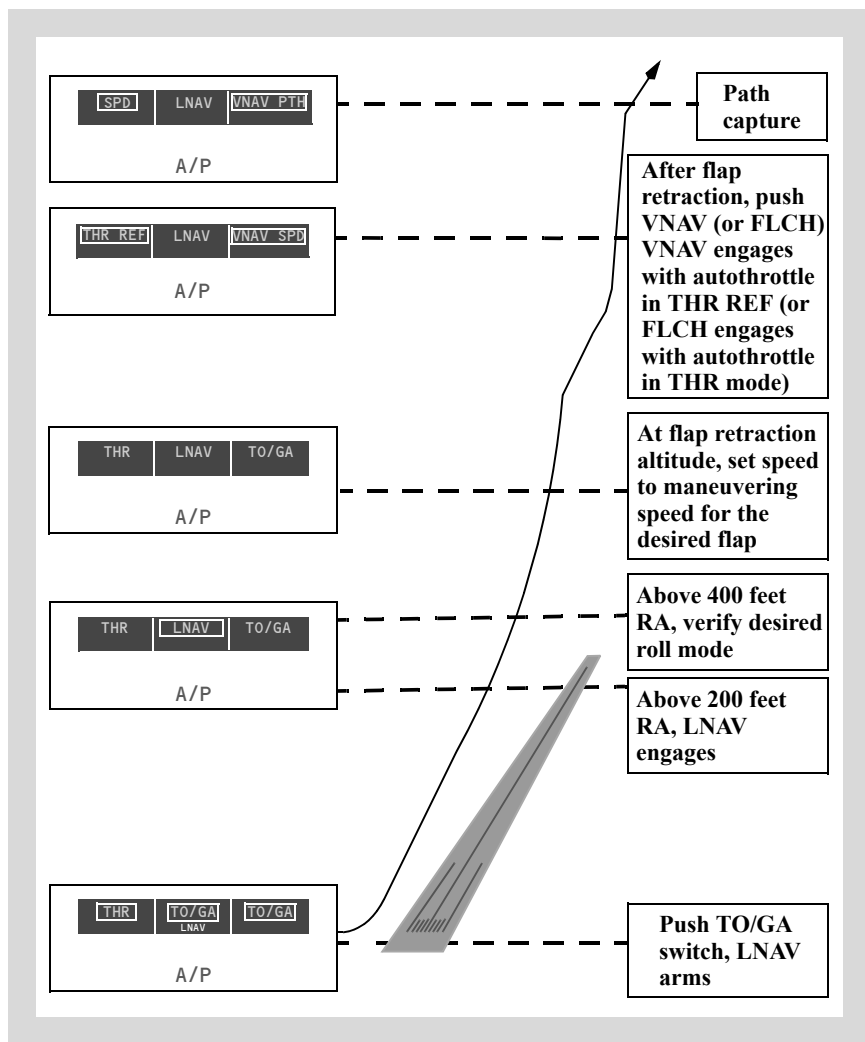
[LNAV auto-engage option - requires AIMS 05]

- go-around remains the engaged roll mode until LNAV automatically engages or another mode is selected.

TO/GA mode termination:

- below 400 feet radio altitude, the AFDS remains in the go-around pitch and roll mode unless:
 - the autopilot is disconnected and both flight directors are turned off, or
 - LNAV automatically engages (after automatic LNAV engagement, a different roll mode can be selected)
- above 400 feet radio altitude, select a different MCP pitch or roll mode.

Automatic Flight Go-Around Profile



Automatic Flight Windshear Recovery

The AFDS provides windshear recovery guidance by means of the normal go-around pitch and roll modes. Go-around is engaged by pushing a TO/GA switch. The AFDS commands a pitch-up of 15 degrees or slightly below the pitch limit, whichever is lower.

As rate of climb increases, the AFDS transitions from pitch to airspeed control. The target airspeed is IAS/MACH window airspeed or current airspeed, whichever is greater when TO/GA is engaged. If current airspeed remains above the selected speed for 5 seconds, the selected airspeed is reset to current airspeed, (to a maximum of the IAS/MACH window speed plus 25 knots).

If the autopilot is not engaged when go-around is initiated, the pilot must fly the windshear recovery following the flight director commands. If the autothrottle is not armed, the thrust levers must be advanced manually.

Flight Envelope Protection

There are three forms of flight envelope protection in the autopilot:

- stall protection
- overspeed protection
- roll envelope bank angle protection.

An AUTOPILOT caution message and roll or pitch mode failures alert the pilot if the envelope is exceeded, and the autopilot prevents further envelope violations.

Refer to Chapter 9, Flight Controls, for a description of flight envelope protection.

Intentionally
Blank

Automatic Flight

EICAS Messages

Chapter 4

Section 30

Automatic Flight EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Aural	Message Logic
AUTOPILOT	Caution	Beeper	Autopilot is operating in a degraded mode. Engaged roll and/or pitch mode may have failed, or the autopilot has entered envelope protection.

[Option - siren or wailer]

AUTOPILOT DISC	Warning	Siren	Autopilot has disconnected.
----------------	---------	-------	-----------------------------

AUTOTHROTTLE DISC	Caution	Beeper	Both autothrottles have disconnected.
AUTOTHROTTLE L, R	Advisory		Affected autothrottle is OFF or has failed.
NO AUTOLAND	Caution Advisory	Beeper	Autoland is not available. Message is a caution if fault occurs after LAND 3 or LAND 2 is annunciated, or approach has been selected but does not engage by 600 AGL. Message is an advisory if fault occurs before LAND 3 or LAND 2 is annunciated.
NO LAND 3	Caution Advisory	Beeper	Autoland system does not have redundancy for triple channel autoland. Message is a caution if fault occurs after LAND 3 is annunciated. Message is an advisory if fault occurs before LAND 3 is annunciated.

Intentionally
Blank

Communications**Chapter 5****Table of Contents****Section 0**

Controls and Indicators	5.10
Audio Control Panel	5.10.1
Radio System	5.10.4
Radio Tuning Panel	5.10.4
Radio Tuning Panel Indications	5.10.6
Miscellaneous Communication Controls	5.10.7
Headphone/Boom Microphone [Typical]	5.10.7
Hand Microphone [Typical]	5.10.8
Oxygen Mask Microphone [Typical]	5.10.8
Control Wheel Microphone/Interphone Switch	5.10.9
Glareshield Microphone Switch	5.10.9
Service Interphone Switch	5.10.10
Handset	5.10.10
Flight Deck Speaker	5.10.12
Boom Microphone/Headphone Panel	5.10.12
Observer Audio Selector	5.10.13
Call Panel	5.10.13
Flight Deck Call Switch	5.10.15
Cargo Interphone Component Locations	5.10.16
Cargo Interphone Components	5.10.17
Data Link Accept/Cancel/Reject Switches	5.10.20
Cockpit Voice Recorder System	5.10.21
Cockpit Voice Recorder Panel	5.10.21
Cockpit Voice Recorder Microphone [Typical]	5.10.23
Cockpit Voice Recorder Switch	5.10.23
Printer Controls	5.10.24
System Description	5.20
Introduction	5.20.1
Audio Control Panels	5.20.1
Cockpit Voice Recorder System	5.20.2

Radio Tuning Panels	5.20.2
Radio Communication Systems	5.20.2
VHF Communication System	5.20.2
HF Communication System	5.20.3
Stuck Mic Protection	5.20.4
SELCAL System	5.20.4
SATCOM System	5.20.4
SATCOM Phone Pages [Typical]	5.20.4
SATCOM Directory Index Page [Typical]	5.20.6
SATCOM Directory Page [Typical]	5.20.7
Communication Crew Alerting System	5.20.7
Crew Alert Categories	5.20.8
Main Deck Alert System	5.20.8
Interphone Systems	5.30
Interphone Communication System	5.30.1
Flight Interphone System	5.30.1
Service Interphone System	5.30.2
Passenger Address System	5.30.2
Personnel Address System	5.30.2
Cabin Interphone System	5.30.3
CDU Menu Page	5.30.4
Cabin Interphone CDU Controls	5.30.5
Cabin Interphone Main Menu	5.30.5
Cabin Interphone Main Menu Page [Typical]	5.30.6
Cabin Interphone Directory Page [Typical]	5.30.7
Cabin Interphone Subdirectory Page [Typical]	5.30.8
Cabin Interphone System	5.30.9
Cargo Interphone System	5.30.10
Cargo Intercom System	5.30.10
MFD Communications Functions	5.40
Introduction	5.40.1

Communications Menus	5.40.2
Communications Control and Input Functions	5.40.4
Command Key Locations	5.40.4
Command Key Functions	5.40.5
Text Entry	5.40.9
Menu Entry Fields	5.40.10
Invalid Entries	5.40.10
Message List	5.40.11
Message Display Format	5.40.12
Exclusive and Nonexclusive Select Keys	5.40.13
Information Messages	5.40.14
Communications Information Messages	5.40.14
Uplink Message	5.40.15
ATC Data Link	5.40.18
Crew Feedback	5.40.18
FMC Data Loading	5.40.18
Downlink Pages	5.40.19
ATC Menu	5.40.19
Altitude Request	5.40.20
Altitude Request Reason Page	5.40.21
Route Request	5.40.22
Speed Request	5.40.24
Clearance Request	5.40.25
Combination Downlink Request	5.40.26
When Can We Expect	5.40.27
Voice Contact Request	5.40.28
ATC Logon/Status	5.40.28
ATC Connection Displays	5.40.31
Emergency Report	5.40.32
ATC Reports	5.40.34
ATC Requested Report	5.40.34
Armable Report	5.40.35
Position Report	5.40.36
Optional Position Report Items	5.40.38

Free Text Message	5.40.39
Flight Information	5.40.39
Flight Information Menu	5.40.39
Departure Clearance Request	5.40.40
Oceanic Clearance Request	5.40.41
ATIS Request	5.40.43
Company Menu	5.40.45
Company Downlink Message Page	5.40.46
Review Menu	5.40.47
Review State Indicators	5.40.48
Manager Functions	5.40.49
Manager Menu	5.40.49
ACARS Manager	5.40.50
ACARS Manager Page 2/2	5.40.51
VHF Manager	5.40.52
HF Manager	5.40.53
SATCOM Manager	5.40.53
Automatic Dependent Surveillance Manager	5.40.54
System Information Manager	5.40.54
Printer Manager	5.40.55
Automatic Messages Manager	5.40.56
Master Manager	5.40.56
Manager Messages	5.40.57
New Messages	5.40.59
New Messages Menu	5.40.59
New Message – No Response Required	5.40.60
New Message – Response Required	5.40.61
EICAS Messages	5.50
Communications EICAS Alert Messages	5.50.1
EICAS Communication Messages	5.50.2

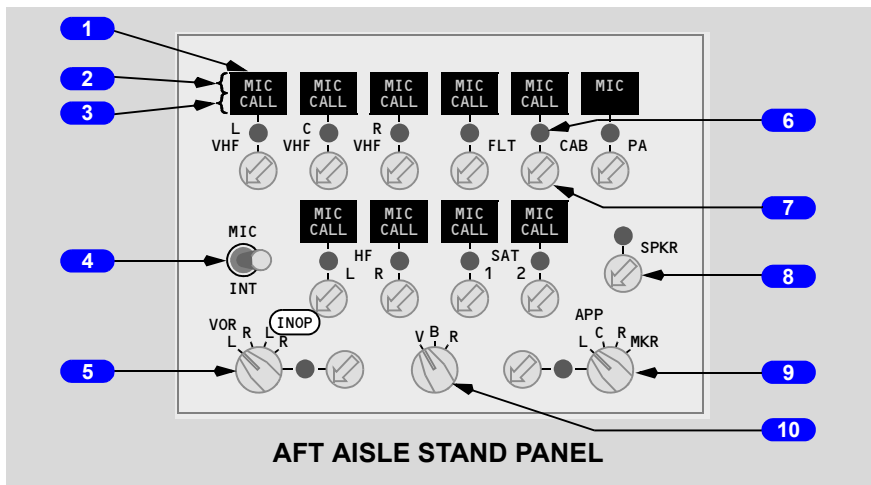
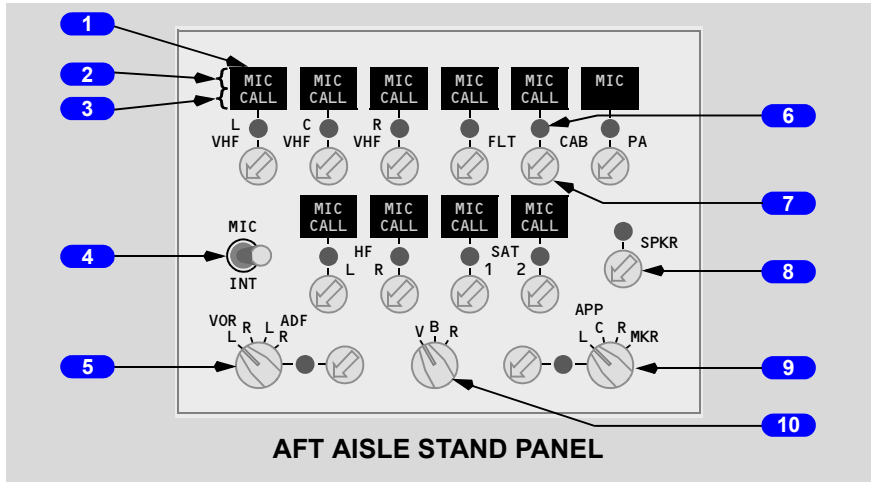
Communications

Controls and Indicators

Chapter 5

Section 10

Audio Control Panel



1 Transmitter Select Switches

Push –

- the MIC light illuminates
- the MIC light for any other transmitter extinguishes

- selects the respective transmitter (radio or intercommunications) for transmission from this crew station (only one can be selected at a time for each crew station)
- selects the receiver audio on, if not already manually selected on

[Passenger]

- pushing the CAB transmitter select switch twice within one second places a priority call to a selected cabin station.

Second push –

- deselects the transmitter
- deselects receiver audio

Note: Second push of the CAB select switch deselects the transmitter and receiver audio only after one second has elapsed from the first push.

2 MIC Lights

Illuminated (green) – indicates the transmitter is selected.

3 CALL Lights

Illuminated (green) –

- indicates a call on SELCAL, the flight interphone (FLT), the cabin interphone (CAB), or SATCOM (SAT)
- resets when the respective transmitter select switch is pushed or, if already pushed, by pressing a MIC/INTERPHONE switch (the SATCOM CALL light remains illuminated until the call ends)
- PA does not have a CALL light

4 MIC/Interphone Switch

MIC – keys the boom microphone or oxygen mask on the selected radio transmitter or other system.

Center – off position (spring-loaded to center).

INT – keys the boom microphone or oxygen mask on the flight interphone.

5 VOR/ADF Receiver Selector

Selects the VOR or ADF receiver to be monitored:

- VOR L – left VOR
- VOR R – right VOR
- ADF L – left ADF
- ADF R – right ADF

5 VOR Receiver Selector

Selects the VOR receiver to be monitored:

- VOR L – left VOR
- VOR R – right VOR

6 Receiver Lights

Illuminated (green) – indicates the respective receiver volume control is manually selected on.

7 Receiver Volume Controls

Push – turns the respective receiver audio on or off.

Rotate – controls receiver volume.

8 Speaker (SPKR) Volume Control

Push – turns the respective flight deck speaker on or off.

Rotate – controls flight deck speaker volume.

9 Approach (APP) Receiver Selector

Selects the approach receiver to be monitored:

- APP L – left ILS
- APP C – center ILS
- APP R – right ILS
- MKR – marker beacon

10 Navigation Filter Selector

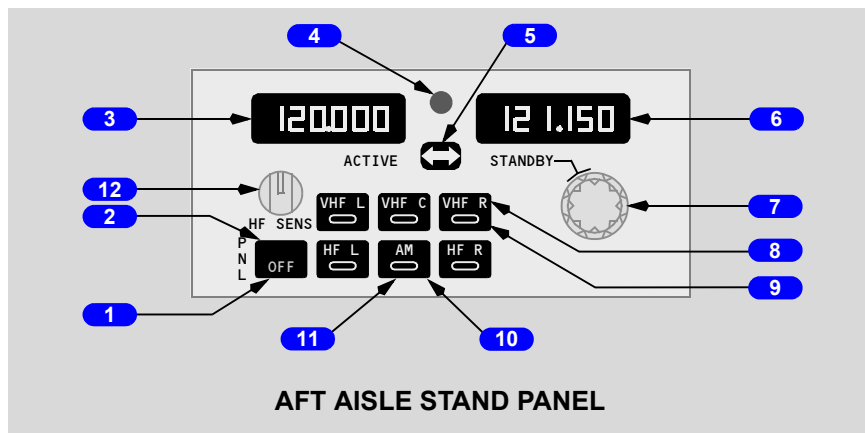
Filters VOR, ADF, ILS, or DME audio:

- V (voice) – only the voice audio is heard
- B (both) – both the voice and range audio are heard
- R (range) – range audio (navigation aid Morse code identifier) is heard

Note: Marker beacon audio is available in all positions.

Radio System

Radio Tuning Panel



1 Radio Tuning Panel OFF Light

Illuminated (green) – the radio tuning panel is off.

2 Radio Tuning Panel OFF Switch

Push – disconnects the panel from the communication radios.

3 ACTIVE Frequency Window

Displays the tuned frequency of the selected radio.

Displays DATA if the selected radio is in the data mode (not applicable for VHF L).

4 Offside Tuning Light

Illuminated (green) –

- the radio normally associated with this panel is being tuned by another radio tuning panel, or
- the radio tuning panel is being used to tune a radio not normally associated with this radio tuning panel

Note: The left radio tuning panel is normally associated with VHF L and HF L. The right radio tuning panel is normally associated with VHF R and HF R. The center radio tuning panel is normally associated with VHF C.

5 Frequency Transfer Switch

Push –

- transfers the STANDBY window frequency to the ACTIVE window and tunes the selected radio to the new active frequency
- transfers the ACTIVE window frequency to the STANDBY window

6 STANDBY Frequency Window

Displays the preselected or previously tuned frequency of the selected radio.

With data link installed, displays DATA when selection of the frequency transfer switch would reconfigure the selected radio to the data mode (not applicable for VHF L).

7 Frequency Selector

Rotate –

- outer knob – selects the portion of the STANDBY frequency to the left of the decimal point
- inner knob – selects the portion of the STANDBY frequency to the right of the decimal point

8 Radio Tuning Switches

Push –

- selects the radio to be tuned
- the tuned frequency is displayed in the ACTIVE frequency window
- the standby frequency is displayed in the STANDBY frequency window

9 Radio Tuning Lights

Illuminated – indicates the selected radio.

10 AM Switch

Push – sets the AM or USB mode for the selected HF.

11 AM Light

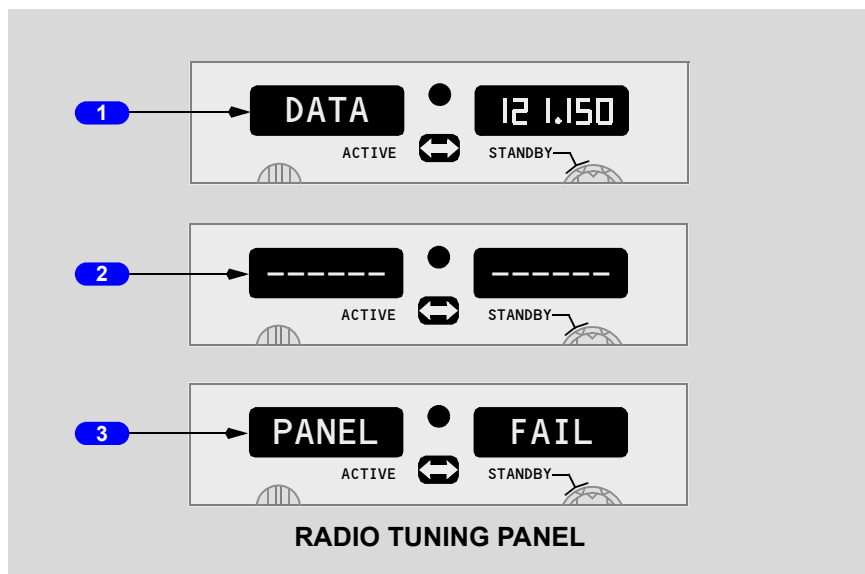
Illuminated – HF AM is selected.

Extinguished – HF USB is selected.

12 HF Sensitivity Control

Rotate – adjusts the sensitivity of the on-side HF receiver.

Radio Tuning Panel Indications



1 DATA Mode

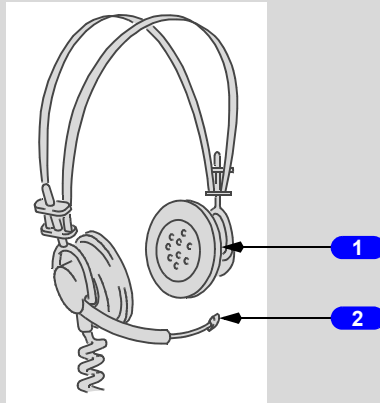
Displays DATA in the ACTIVE frequency window when the selected radio is being used in the data mode.

2 Radio Fail

Displays dashes in both windows when the selected radio is failed or has been disconnected.

3 PANEL FAIL

The radio tuning panel is failed.

Miscellaneous Communication Controls**Headphone/Boom Microphone [Typical]****SIDEWALL PANELS****1 Headphone**

Used to monitor audio from the respective audio control panel.

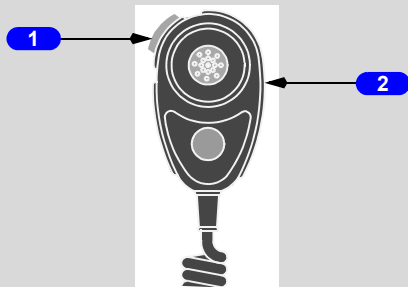
Audio volume is adjusted using audio control panel controls for the associated station.

Available at all flight deck stations.

2 Boom Mic

Activation of a control wheel, glareshield or audio control panel mic/interphone switch transmits on the system selected for use at that station.

Hand Microphone [Typical]



SIDEWALL PANELS

1 Hand Microphone Push-To-Talk Switch

Push – activates the hand microphone.

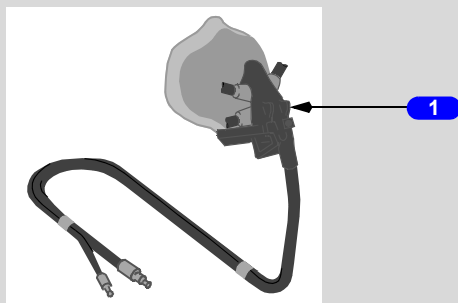
2 Hand Microphone

Transmits on the system selected by the audio control panel.

Available at the Captain, First Officer and First Observer stations.

Optional for the Second Observer station.

Oxygen Mask Microphone [Typical]



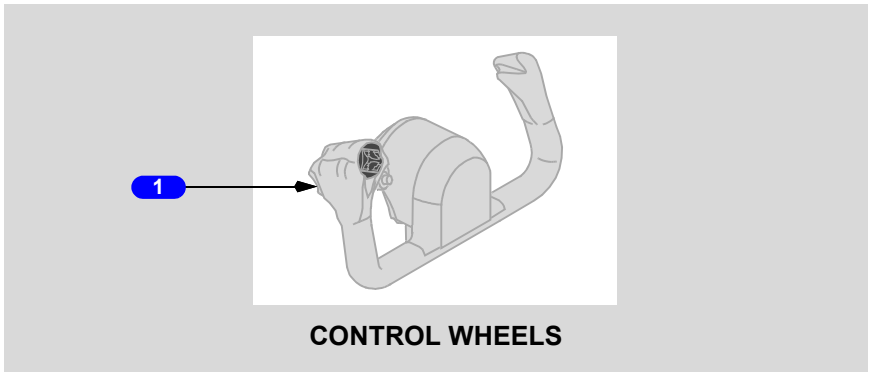
SIDEWALL PANELS

1 Oxygen Mask Microphone

Enabled when the oxygen mask doors are open. The boom microphone is disabled.

Activation of a control wheel, glareshield or audio control panel mic/interphone switch transmits on the system selected for use at that station.

Control Wheel Microphone/Interphone Switch



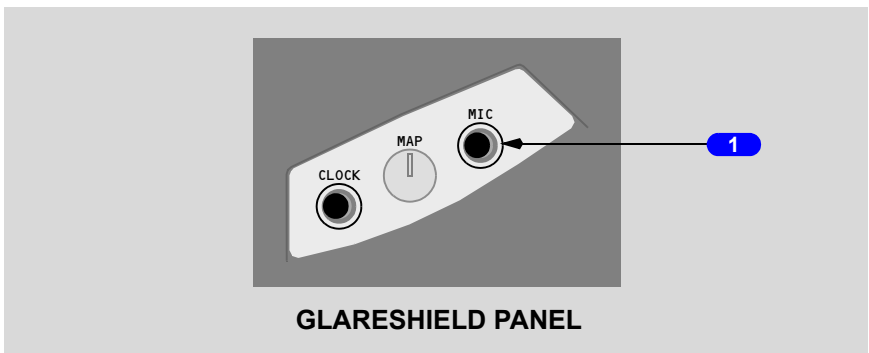
1 Control Wheel Mic/Interphone Switch

MIC – allows oxygen mask or boom microphone transmission on selected transmitter. Spring-loaded to center.

CENTER – off position.

INT – allows oxygen mask or boom microphone transmission on the flight interphone system. Spring-loaded to center.

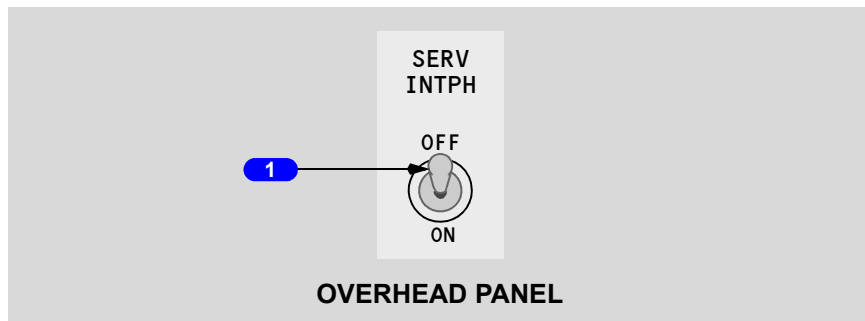
Glareshield Microphone Switch



1 Glareshield Mic Switch

Push – allows oxygen mask or boom microphone transmission on the selected transmitter.

Service Interphone Switch



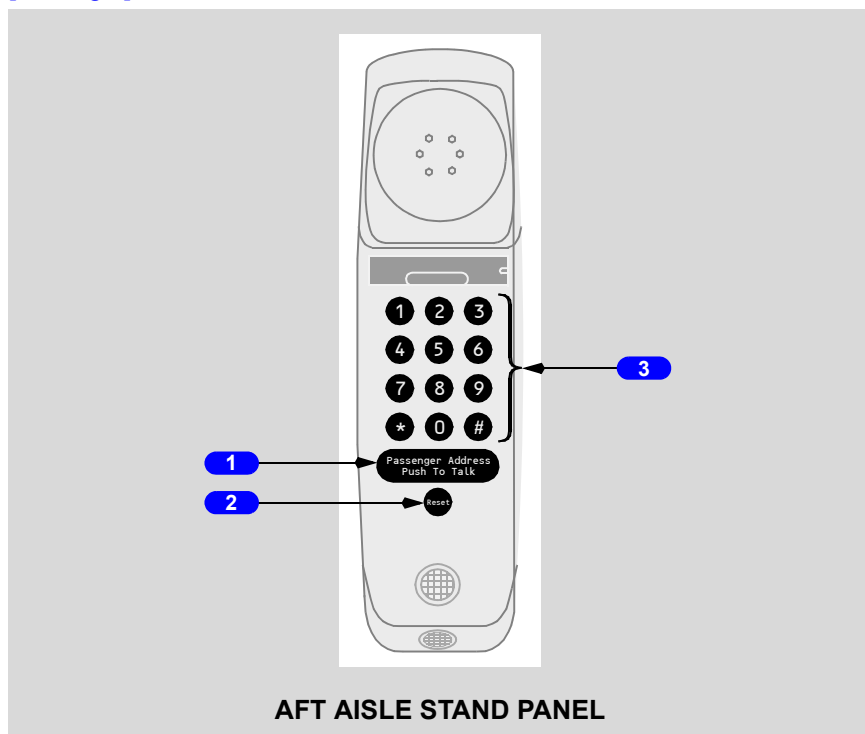
1 Service Interphone Switch

OFF – allows independent operation of the service and flight interphone systems.

ON – connects the service and flight interphone systems.

Handset

[Passenger]



1 Handset PA Push To Talk Switch

Push –

- connects the handset microphone to the selected PA area
- only used in the PA mode

2 Handset Reset Switch

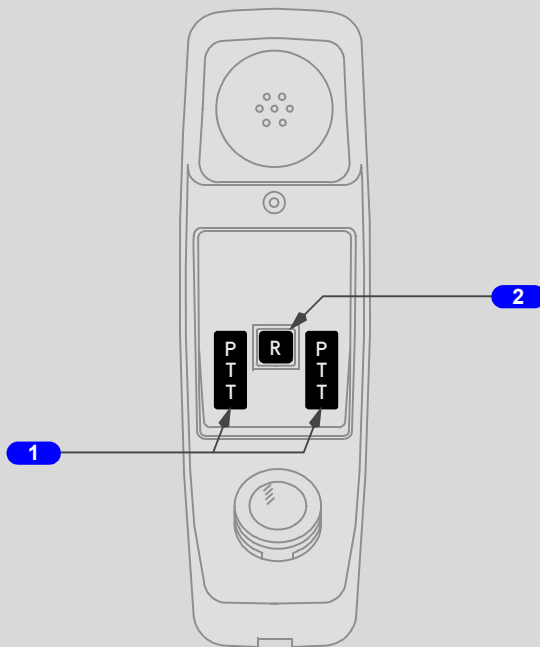
Push – cancels a call or incorrectly selected code.

3 Handset Numeric Keys

Push – selecting a code calls the respective station or PA area.

Note: Dial codes entered using the handset are not displayed on the CDU cabin interphone pages.

[Freighter]



CREW REST AND CABIN

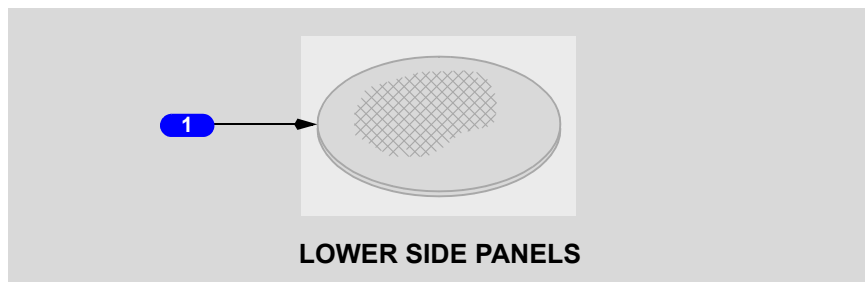
1 PUSH TO TALK Switches

Push - extinguishes FLT DECK call switch light.

2 Reset Switch

Push - cancels call.

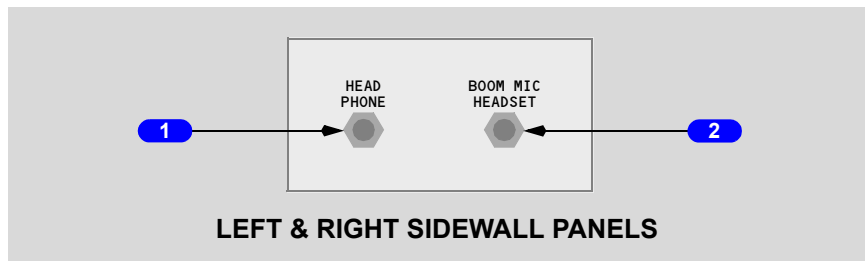
Flight Deck Speaker



1 Flight Deck Speaker

Controlled by the speaker volume control on the respective audio control panel.

Boom Microphone/Headphone Panel



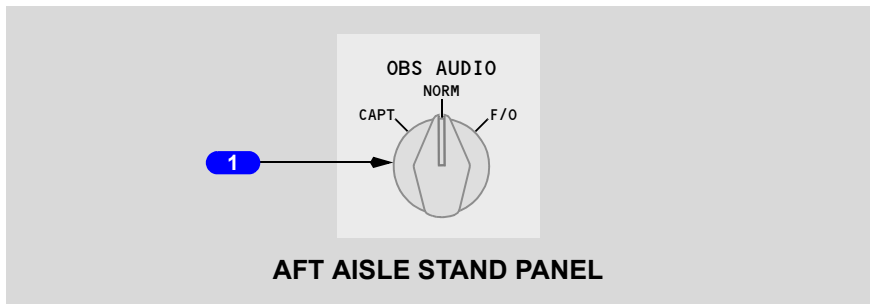
1 Headphone Jack

Accepts a flight crew headphone plug.

2 Boom Mic Jack

Accepts a flight crew boom mic plug.

Observer Audio Selector



1 Observer (OBS) AUDIO Selector

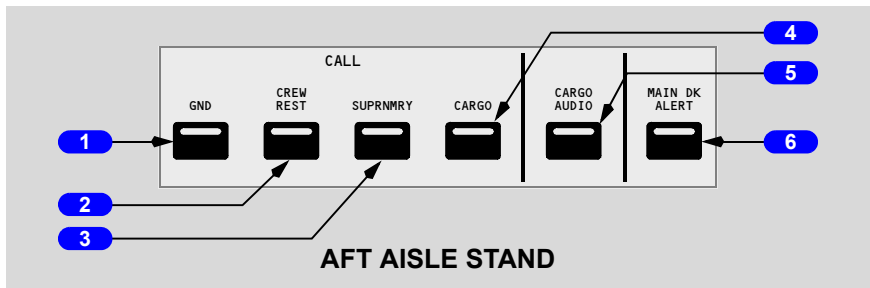
CAPT – connects the Captain's hand microphone, headphone, boom microphone/headset, oxygen mask microphone, speaker, and mic/interphone switches to the First Observer audio control panel.

NORM – the First Observer audio control panel is connected to the First Observer's hand microphone, headphone, boom microphone/headset and oxygen mask microphone.

F/O – connects the First Officer's hand microphone, headphone, boom microphone/headset, oxygen mask microphone, speaker, and mic/interphone switches to the First Observer audio control panel.

Call Panel

[Freighter]



1 Ground (GND) Call Switch

Illuminated (green) - indicates nose wheel well horn is sounding.

Push – sounds three second horn in nose wheel well.

2 CREW REST Call Switch

Illuminated (green) - indicates crew rest is being called. Light extinguishes when call is answered.

Push - illuminates Flight Deck switch on crew rest handset cradle and sounds chime in crew rest area.

Second push (light illuminated) - cancels call to crew rest.

3 Supernumerary (SUPRNMRY) Call Switch

Illuminated (green) - indicates supernumerary is being called. Light extinguishes when call is answered.

Push - illuminates Flight Deck switches on the two supernumerary handset cradles and sounds chime in supernumerary area.

Second push (illuminated) - cancels call to supernumerary area.

4 CARGO Call Switch

Illuminated (green) - indicates cargo area is being called. Light extinguishes when call is answered by any loadmaster amplifier panel or cargo area station.

Push - illuminates Flight Deck switch on loadmaster amplifier panels, wing inspection stations, and cargo speaker/mike stations.

Second push (illuminated) - cancels call to cargo area.

5 CARGO AUDIO Switch

Illuminated (green) - indicates cargo and cabin interphone systems are connected.

Push - disconnects cargo and cabin interphone systems. Cargo and cabin interphones automatically connect for incoming or outgoing calls. Disconnect following cargo call may eliminate circuit noise.

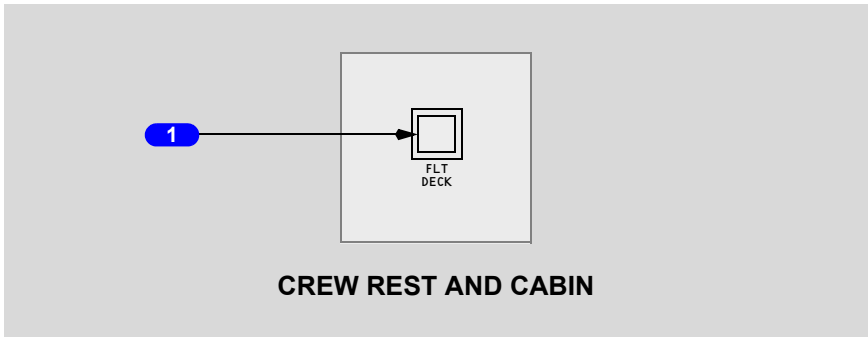
6 MAIN Deck (DK) ALERT Switch

Illuminated (green) - indicates system activation. Extinguishes after several seconds to indicate system reset.

Push - activates main deck aural warning and flashes main deck sidewall lights for several seconds.

Flight Deck Call Switch

[Freighter]



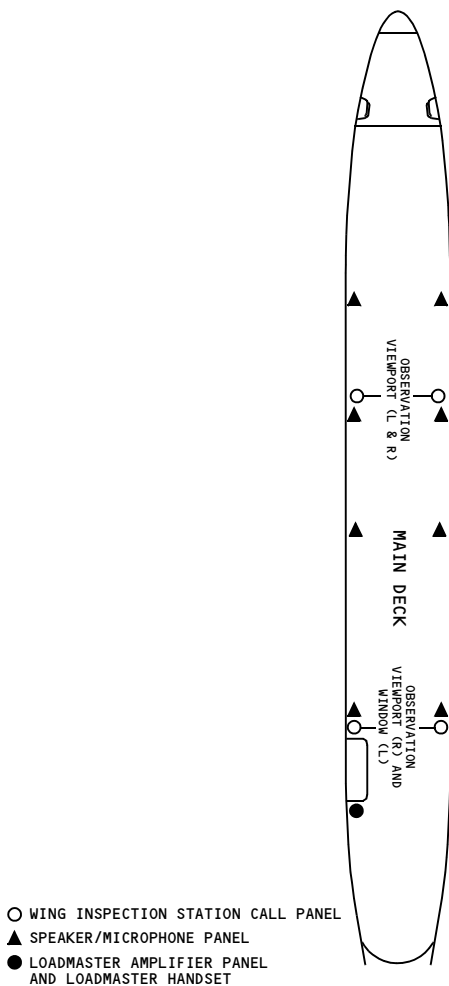
1 Flight (FLT) DECK Call Switch

Illuminated (white) – interphone call from flight deck received, chime also sounds.

Push – sounds chime in flight deck, displays CREW REST CALL or SUPRNMY CALL on EICAS, and illuminates Cabin (CAB) CALL light on audio control panel.

Cargo Interphone Component Locations

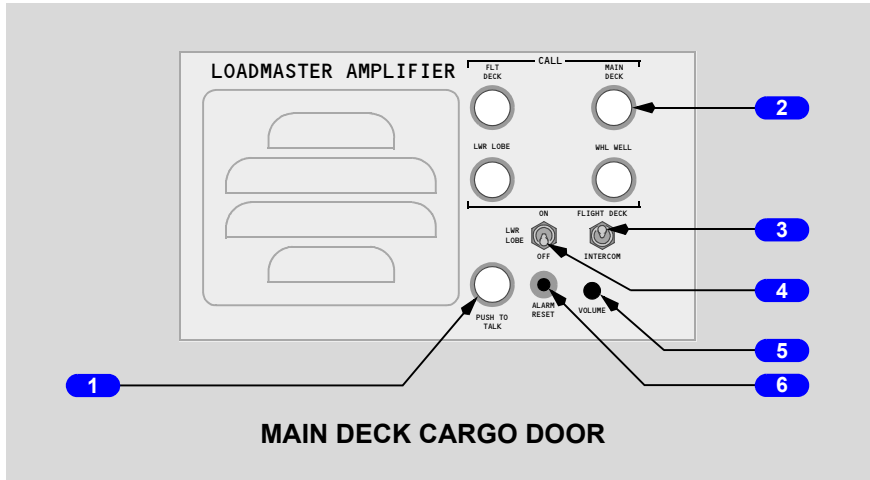
[Freighter]



Cargo Interphone Components

[Freighter]

Loadmaster Amplifier Panel



1 PUSH TO TALK Switch

Push - activates loadmaster amplifier panel microphone and connects to any selected area except flight deck.

2 CALL Switches

Illuminated (white) - indicates a call from the respective area. Extinguishes when pushed.

Push - sounds a chime in area being called.

3 FLIGHT DECK/INTERCOM Switch

FLIGHT DECK - connects loadmaster amplifier panel handset to flight deck interphone. Handset must be used for communication with flight deck.

INTERCOM - connects loadmaster panel to main cargo deck speaker/microphone panels.

4 LOWER LOBE Switch

ON - activates lower lobe speaker/microphone panels.

OFF - deactivates lower lobe speaker/microphone panels.

5 VOLUME Selector

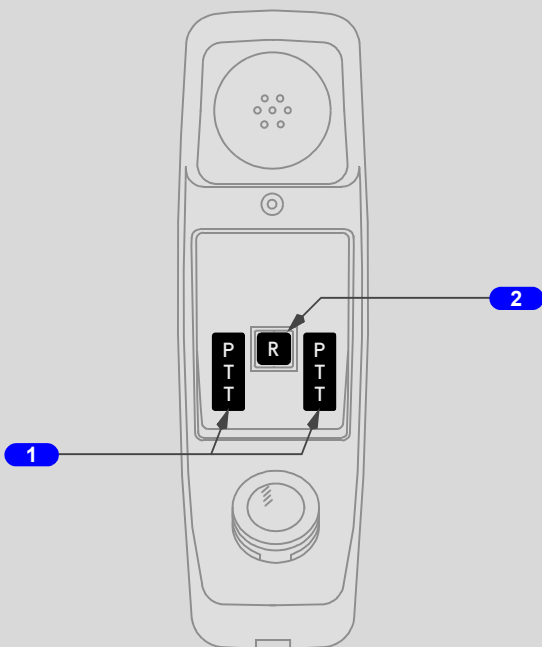
Rotate - adjusts loadmaster amplifier panel speaker volume.

6 ALARM RESET Switch

Push - resets aft c.g. audio alarm.

Loadmaster Handset

The loadmaster handset provides communications on cargo interphone and intercom systems.



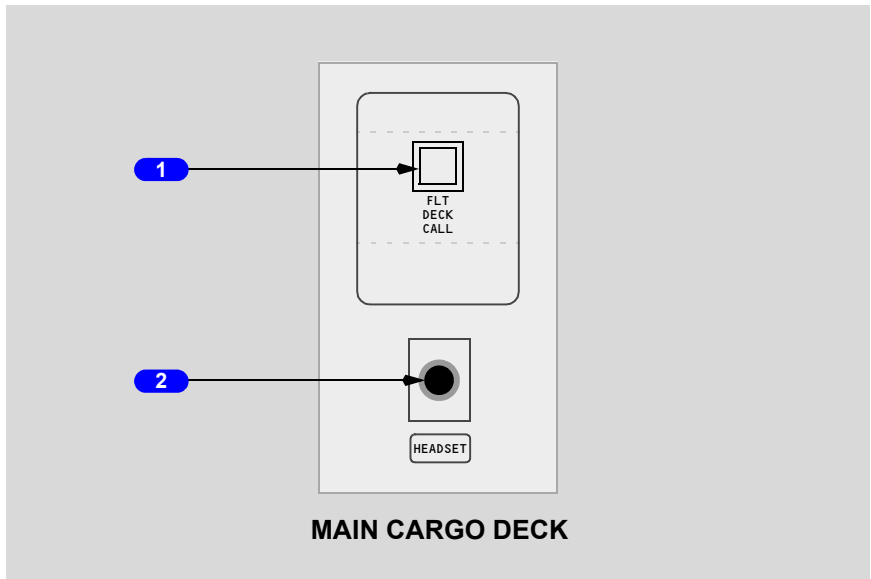
MAIN DECK CARGO DOOR

1 PUSH TO TALK Switches

Push - extinguishes Call switch lights.

2 Reset Switch

Push - cancels call.

Wing Inspection Station Call Panel**1 Flight (FLT) DECK CALL Switch**

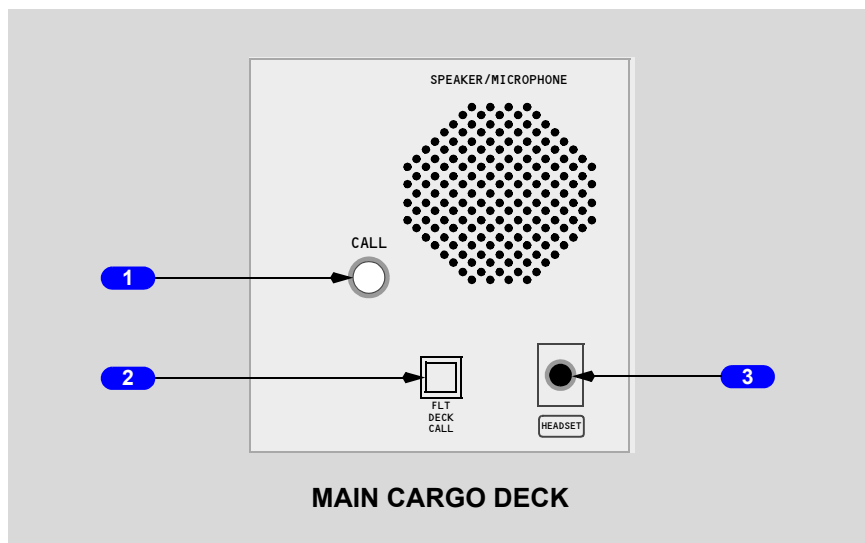
Illuminated (white) - interphone call from flight deck received. Extinguishes when pushed.

Push - sounds chime in flight deck, displays CARGO CALL on EICAS, and illuminates Cabin (CAB) CALL light on audio control panel.

2 HEADSET Jack

Receptacle for headset connection.

Main Cargo Deck Speaker/Microphone Panel



1 CALL Switch

Push (on ground) - sounds a tone and illuminates Main Deck Call switch on loadmaster amplifier panel.

2 Flight (FLT) DECK CALL Switch

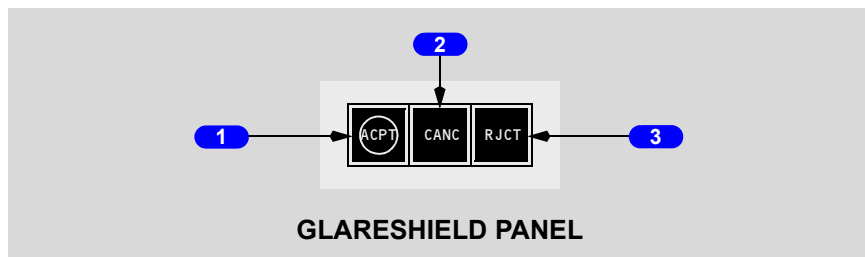
Illuminated (white) - interphone call from flight deck received. Extinguishes when pushed.

Push - sounds chime in flight deck, displays CARGO CALL on EICAS, and illuminates Cabin (CAB) CALL light on audio control panel.

3 HEADSET Jack

Receptacle for headset connection.

Data Link Accept/Cancel/Reject Switches



1 Accept (ACPT) Switch

Push –

- a positive response to a displayed message is downlinked to the origin of the displayed message
- functions the same as selecting an MFD communications display ACCEPT command key

2 Cancel (CANC) Switch

Push –

- the message is removed from the display
- functions the same as selecting an MFD communications display CANCEL command key

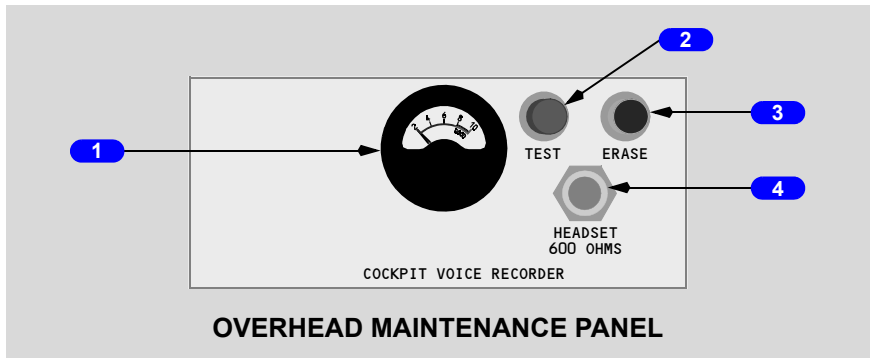
3 Reject (RJCT) Switch

Push –

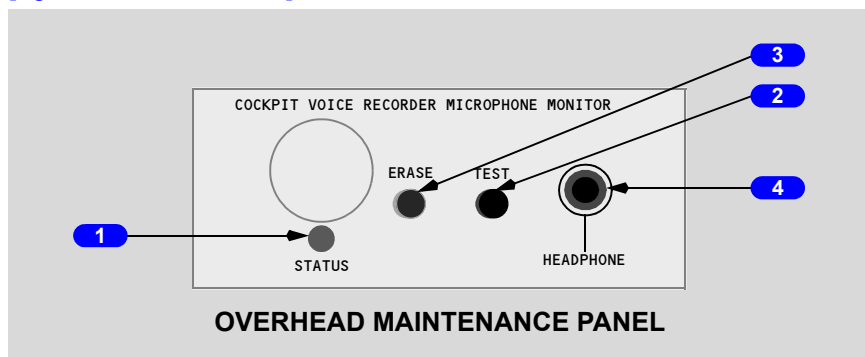
- a negative response to the displayed message is downlinked to the origin of the displayed message
- functions the same as selecting an MFD communications display REJECT command key

Cockpit Voice Recorder System**Cockpit Voice Recorder Panel**

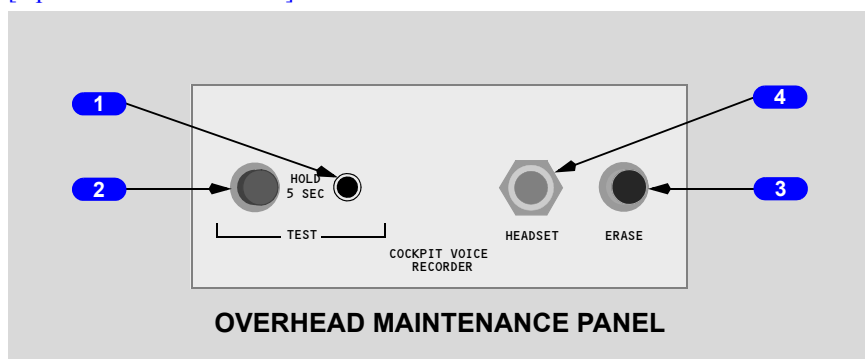
[Option – Voice Monitor Indicator]



[Option – Status Indicator]



[Option – Status Indicator]



1 Cockpit Voice Monitor Indicator

[Option]

Pointer deflection indicates recording or erasure on all channels.

During test, the pointer rises into the green band.

1 STATUS Indicator

[Option]

Illuminated – test completed successfully. Extinguished after one second.

1 STATUS Indicator

[Option]

Illuminated – test completed successfully. Extinguished after button is released.

2 Cockpit Voice Recorder TEST Switch

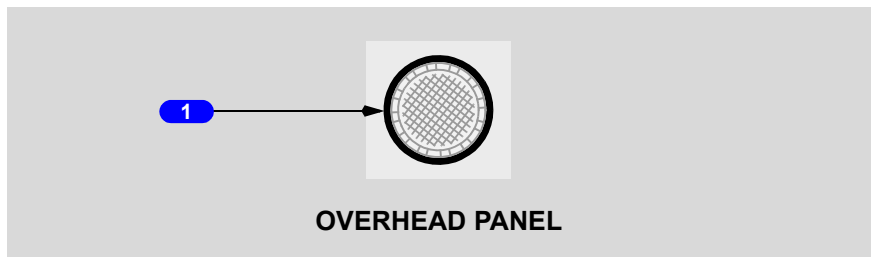
Push and hold for five seconds – tests all four cockpit voice recorder channels (1 per second).

3 Cockpit Voice Recorder ERASE Switch

Push and hold for three seconds – erases voice recorder if on the ground, AC power on, and parking brake set.

4 Cockpit Voice Recorder Headset Jack

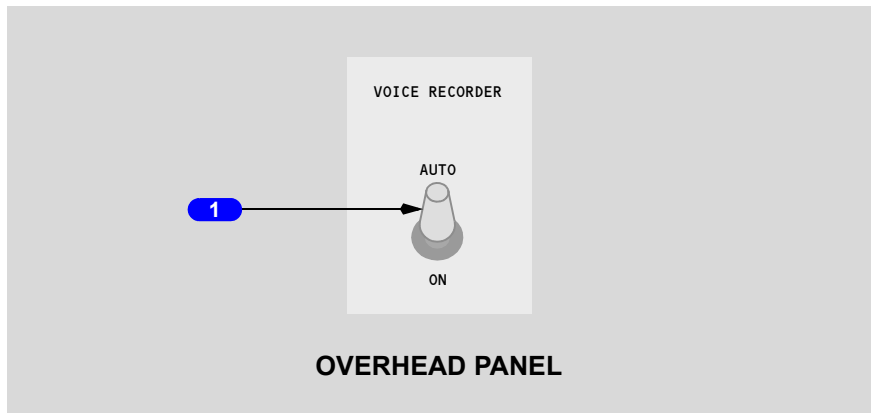
A headset may be plugged in to monitor playback of voice audio, or to monitor tone transmission during test.

Cockpit Voice Recorder Microphone [Typical]**1 Cockpit Voice Recorder Microphone**

Area microphone for the voice recorder.

Cockpit Voice Recorder Switch

[Option]



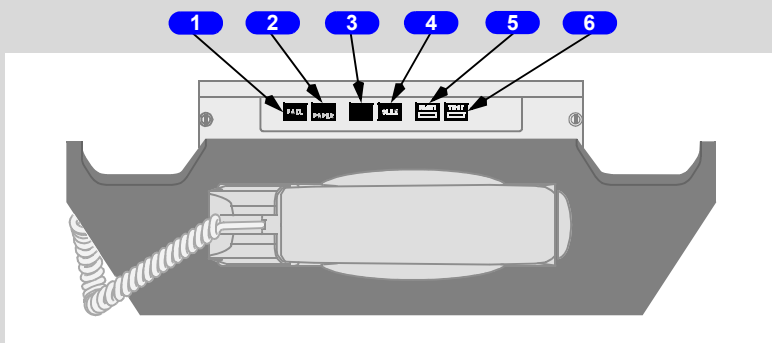
1 VOICE RECORDER Switch

AUTO – The cockpit voice recorder runs from first engine start until 5 minutes after last engine shutdown (spring-loaded).

ON – The cockpit voice recorder runs until first engine start, then spring-loaded to AUTO.

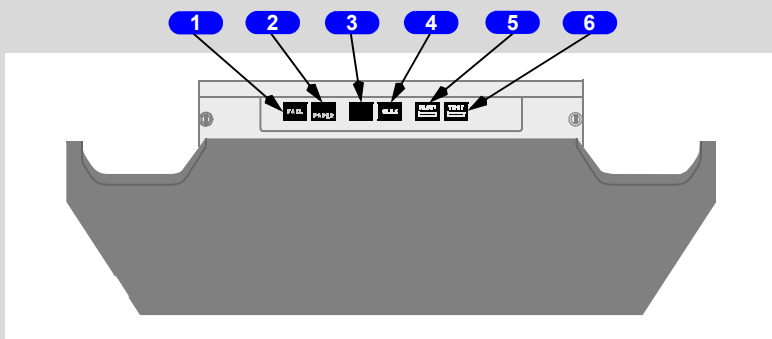
Printer Controls

[Passenger]



AFT AISLE STAND PANEL

[Freighter]



AFT AISLE STAND PANEL

1 Printer FAIL Light

Illuminated amber –

- the printer is failed

2 Printer PAPER Light

Illuminated PAPER (amber):

- the printer is out of paper, or
- the paper is jammed

3 Switch is not functional**4 Printer SLEW Switch**

Push and hold – advances the printer paper.

5 Printer RESET Switch

Push – resets the printer if it stops operating.

6 Printer TEST Switch

Push –

- tests the printer and printer lights
- prints a test pattern

Intentionally
Blank

**Communications
System Description****Chapter 5
Section 20****Introduction**

The communication systems include:

- cockpit voice recorder system
- radio communication system
- SELCAL system
- SATCOM system
- communication crew alerting system
- interphone communication system (refer to Section 30 of this chapter)

[Freighter]

- main deck alert system
- data communication system (refer to Section 40 of this chapter).

The communication systems are controlled using the:

- audio control panels
- radio tuning panels

[Passenger]

- CDU communications pages (refer to Section 30 of this chapter)

[Freighter]

- call panel
- MFD communications pages (refer to Section 40 of this chapter)

Audio Control Panels

The audio control panels are used to manage the radio and interphone communication systems. Navigation receiver audio can also be monitored. The Captain, First Officer, and First Observer audio control panels are installed on the aft aisle stand.

Microphones are keyed by pushing the desired audio control panel transmitter select switch and using the MIC position of a control wheel or audio control panel microphone/interphone switch, a glareshield MIC switch, or a hand microphone push-to-talk switch. Systems are monitored using headphones or speakers. An oxygen mask microphone is enabled and the boom microphone is disabled when the oxygen mask stowage doors are open. The oxygen mask microphone is disabled and the boom microphone is enabled when the left oxygen mask stowage box door is closed and the RESET/TEST switch is pushed.

Cockpit Voice Recorder System

The cockpit voice recorder records any transmitted or received flight deck audio as selected on the audio control panels. It also records flight deck area conversations using an area microphone and crewmember boom, oxygen mask, and hand microphones, independent of microphone/interphone switch positions. All inputs are recorded continuously.

Radio Tuning Panels

The radio tuning panels are used to tune the VHF and HF radios. The panels are designated left, center, and right, and are normally associated with the respective VHF and HF radios.

Radio Communication Systems

The radio communication systems consist of the VHF communication system, the HF communication system, the SATCOM system, and the SELCAL system.

VHF Communication System

Three independent VHF voice/data radios, designated VHF L, VHF C, and VHF R are installed. Any VHF radio can be controlled by any radio tuning panel. The audio control panels are used to control voice transmission and receiver monitoring.

[Option]

When a VHF radio is tuned to frequency 121.5, all flight crew automatically monitor the radio. The receiver lights on all audio control panels illuminate.

VHF L is configured for voice communication only. VHF C and VHF R can be configured for data or voice communication. However, only one VHF radio can operate in the data mode at a time. Data communication is normally selected on VHF C.

Data Mode

The data mode can be selected and deselected on the MFD COMM display or by pushing the frequency transfer switch on the radio tuning panel. If the selected VHF radio is the default data radio (selected on the MFD COMM display), then the word DATA is displayed in the radio tuning panel active frequency window. When a standby frequency is transferred to the active window, DATA is displayed in the standby window. If a new frequency is selected in the standby window when DATA is displayed, DATA is replaced by the new frequency. Data can be returned to the standby window by selecting a frequency higher or lower than the allowable VHF frequency range.

When a VHF radio is in the data mode, it is not available for voice communications. A VHF radio can be returned to the voice communication mode by transferring a voice frequency into the ACTIVE frequency window.

HF Communication System

There are two independent HF communication radios, designated HF L and HF R. Each HF radio can be tuned by any radio tuning panel. HF radio sensitivity can only be set on the on-side radio tuning panel.

The audio control panels are used to control voice transmission and receiver monitoring.

When an HF transmitter is keyed after a frequency change, the antenna tunes while a continuous tone can be heard through the audio system. A tone lasting longer than 7 seconds indicates failure of the system to tune.

When an HF transmitter is keyed after a frequency change, the antenna tunes while a continuous or intermittent tone may be heard through the audio system. A tone lasting longer than 7 seconds indicates failure of the system to tune. Data is stored in memory for the last 100 tuned frequencies. Stored frequencies may tune quickly and a tone may not be noticeable.

Both HF radios use a common antenna. When either HF radio is transmitting, the antenna is disconnected from the other HF radio, and it cannot be used to transmit or receive. However, both HF radios can receive simultaneously if neither is being used for transmitting.

HF L and HF R can be configured for data or voice communication. However, only one HF radio can operate in the data mode at a time.

Data Mode

The data mode can be selected and deselected on the MFD COMM display or by pushing the frequency transfer switch on the radio tuning panel. If the selected HF radio is the default data radio (selected on the MFD COMM display), then the word DATA is displayed in the radio tuning panel active frequency window. When a standby frequency is transferred to the active window, DATA is displayed in the standby window. If a new frequency is selected in the standby window when DATA is displayed, DATA is replaced by the new frequency. Data can be returned to the standby window by selecting a frequency higher or lower than the allowable HF frequency range.

HF data link operation is inhibited on the ground. When an HF radio is in the data mode, it is not available for voice communications. An HF radio can be returned to the voice communication mode by transferring a voice frequency into the ACTIVE frequency window.

Stuck Mic Protection

In the event a VHF or HF radio transmits for more than 30 seconds, the EICAS advisory message RADIO TRANSMIT is displayed. The message is removed when the transmission stops.

On the ground with both engines shut down, any VHF radio that transmits for more than 35 seconds is automatically disabled and dashes appear in the tuning panel frequency window for that radio. That radio is enabled when the microphone switch for that radio is released.

| SELCAL System

The SELCAL system monitors the three VHF radios and the two HF radios. When the system receives a call from a ground station, the crew is alerted through the communication crew alerting system.

| SATCOM System

The SATCOM system provides both data and voice communications. The system is managed by the satellite data unit. Flight deck voice calls are controlled using the CDUs and audio control panels.

The SATCOM control pages are displayed by selecting SAT on the CDU menu page. Directories of airline-defined numbers are line-selectable or numbers may be manually entered if function is enabled by the operator.

Incoming SATCOM calls are annunciated by a SELCAL chime and illumination of a CALL light on the audio control panel. Pressing the respective transmitter select switch connects the call to the pilot headset/hand mic.

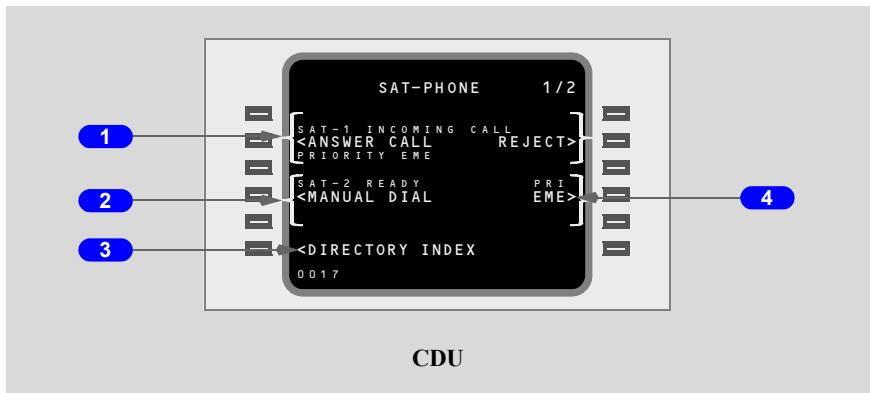
SATCOM calls are terminated when the CALL light extinguishes (ground party hang-up or pilot ends call).

The EICAS communication message SATCOM MESSAGE displays when a SATCOM message requires flight crew attention. Servicing the message clears the EICAS message.

SATCOM Phone Pages [Typical]

[Option]

The SATCOM phone pages allow the flight crew to initiate, answer and terminate calls, monitor call status, and access lower-level pages. Control functions are active when displayed with a caret.

SATCOM Phone Page 1/2**1 Channel 1 Control Field**

Push – selects active control function, priority level, or manual phone number entry from scratchpad. Channel 1 status/call information displays in small font.

2 Channel 2 Control Field

Push – selects active control function, priority level, or manual phone number entry from scratchpad. Channel 2 status/call information displays in small font.

3 DIRECTORY INDEX

Push – displays SATCOM directory index page.

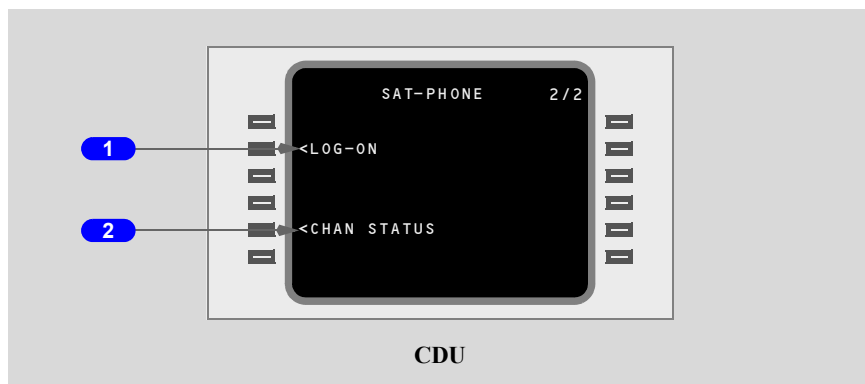
4 PRIORITY (PRI)

The following call priority levels can display:

- Emergency (EME) - emergency and distress calls (activates ground station alarm)
- High (HGH) - regulatory and flight safety calls
- LOW - non-safety related service calls

Push – toggles between levels for selecting call priority.

SATCOM Phone Page 2/2



1 LOG-ON

Push – displays SATCOM log-on page for manual selection and control of log-on process.

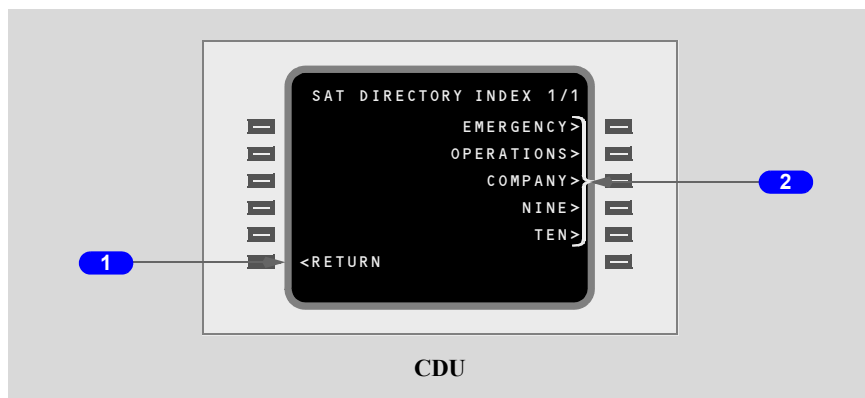
2 Channel (CHAN) STATUS

Push – displays SATCOM channel status page.

SATCOM Directory Index Page [Typical]

[Option]

The SATCOM directory index page is used to access directory pages.



1 RETURN

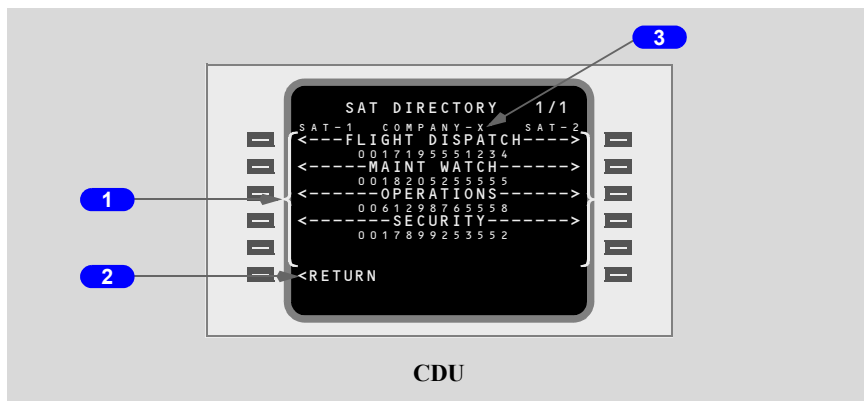
Push – display returns to SATCOM phone page 1/2.

2 Index Labels

Push – displays SATCOM directory page associated with selected index label. Index labels are defined by the operator.

SATCOM Directory Page [Typical]**[Option]**

The SATCOM directory page contains a list of phone numbers used for making line-selectable calls.

**1 Phone Number List**

Push – preselects phone number for making call, selects voice channel via left (SAT 1) or right (SAT 2) line select key, and returns display to SATCOM phone page 1/2. Phone number labels and content are defined by the operator.

2 RETURN

Push – display returns to SATCOM directory index page.

3 Index Label

Displays index label associated with selected SATCOM directory page.

Communication Crew Alerting System

The communication crew alerting system provides aural and visual alerts for normal operations requiring crew awareness that may require crew action. Visual alerts are presented as EICAS messages preceded by a bullet symbol (•). The aural alert is a high-low chime. The following table shows communication crew alert categories and the respective aural and visual alerts for each category. Refer to section 50 of this chapter for a list of possible messages.

Crew Alert Categories

Communication Crew Alert Category	Aural Alert	Visual Alert	Comments
High	High-low chime	Communication EICAS alert	None currently implemented. Reserved for future use.
Medium	High-low chime	Communication EICAS alert	Message awareness required. Crew action may be required.
Low	None	Communication EICAS alert	Crew action may be required.

Main Deck Alert System

[Freighter]

The main deck alert system activates an aural warning and flashes the cargo area sidewall lights for several seconds to alert crewmembers in the main deck cargo compartment to return to the cabin. The system activates automatically upon main cargo deck smoke detection or cabin depressurization, or manually by pushing the MAIN DK ALERT switch on the flight deck call panel. The switch light illuminates to indicate system activation and extinguishes to indicate reset.

Communications
Interphone Systems**Chapter 5**
Section 30**Interphone Communication System**

The interphone communication system includes the:

[Passenger]

- flight interphone system
- cabin interphone system
- service interphone system
- passenger address (PA) system

[Freighter]

- flight interphone system
- cabin interphone system
- service interphone system
- personnel address (PA) system
- cargo interphone system
- cargo intercom system

The flight interphone, service interphone, and PA systems are normally operated through the audio control panel.

[Passenger]

The cabin interphone system is operated through the audio control panel, CDU, and flight deck handset.

[Freighter]

The cabin and cargo interphone systems are operated through the audio control panel and flight deck call panel.

Flight Interphone System

The flight interphone system provides communications on the flight deck and between the flight deck and the ground crew through the flight interphone jack on the APU ground control fire protection panel in the nose landing gear wheel well.

The system is used by selecting the INT (interphone) position of a control wheel or audio control panel mic/interphone switch. The interphone can also be used by selecting the FLT transmitter selector on an audio control panel and then selecting one of the following microphone switches:

- MIC position of a control wheel switch
- MIC position of an audio control panel mic/interphone switch
- a hand microphone push to talk switch
- a glareshield MIC switch

Note: Voice level from the flight deck speakers decreases when selecting the MIC/INT switch on the ACP or control wheel, the PTT switch on the hand microphone, or the MIC switch on the glareshield.

Crew alerting of a ground crew initiated call is provided by an aural alert chime, the GROUND CALL EICAS communications alert message, and a CALL light illuminated on the audio control panel transmitter select switch.

[Passenger]

The ground crew is called by selecting the GND CREW dial code from the center CDU.

[Freighter]

The ground crew is called by pushing the GND call switch on the call panel.

Service Interphone System

The service interphone system provides voice communications between ground crew stations at various locations around the airplane. The system can be connected to the flight interphone system through the service interphone switch on the overhead panel.

Passenger Address System

[Passenger]

The PA system is used by the flight crew to make cabin announcements. Pushing a PA transmitter select switch on an audio control panel and activation of a microphone switch provides direct access to all PA areas.

The system is monitored by pushing the PA receiver volume control on an audio control panel. The PA system can also be selected through the cabin interphone system or the flight deck handset.

Cabin PA announcement priorities are:

- flight deck announcements from an audio control panel
- cabin handset direct access announcements
- priority (all area) announcements
- normal announcements from flight attendant or flight deck handsets

Personnel Address System

[Freighter]

The PA system is used by the flight crew to make announcements to the supernumerary and crew rest areas. Pushing a PA transmitter select switch on an audio control panel and activation of a microphone switch provides direct access to all PA areas.

Cabin Interphone System

[Passenger]

The cabin interphone system provides voice communications between the flight deck and the flight attendant stations. Boom microphones, oxygen mask microphones, and hand microphones are used by selecting the CAB transmitter select switch on an audio control panel and pushing the mic/interphone switch to the MIC position. A cabin interphone station(s) must be selected and a call initiated from the center CDU to alert the desired station to pick up the call.

EICAS communications alert messages and chimes alert the pilots to incoming cabin calls. Normal priority calls from the cabin display the CABIN CALL EICAS message. Normal priority calls made to the flight deck while another call is in progress will result in a busy signal at the handset, the calling station being displayed in the call queue, and the CABIN CALL memo message being set in EICAS. The call queue and memo messages will be cleared when communication is established between that calling station and the flight deck. Priority calls from the cabin display the CABIN ALERT EICAS message. Priority calls automatically disconnect lower priority cabin interphone calls. Priority calls placed while a priority call is in progress are automatically connected as a conference call.

The cabin interphone call queue, speed dial numbers, and directories are accessed from the center CDU cabin interphone menu.

Calls are initiated by:

- line selecting the call location on the CDU display, or
- entering the appropriate call code in the CDU scratchpad and selecting SEND

Pushing the audio control panel CAB transmitter select switch twice within one second places a priority call to an airline-designated call location.

A station which is in use will be disconnected from the call in progress and connected to the flight deck.

Note: Flight deck initiated calls will not interrupt a current PA announcement from the dialed station.

Calls can be answered by selecting an audio control panel CAB transmitter select switch or, if a CAB transmitter select switch is already pushed in, by pressing a mic/interphone switch to the MIC position.

Calls can be ended by selecting the CDU prompt END CALL or de-selecting the CAB transmitter selector on the audio control panel. The call also ends if the other party terminates the call.

Calls can also be answered or placed using the flight deck handset. Desired call locations are entered using the numeric keys on the handset. Pressing the handset reset switch or placing the handset back on the cradle terminates the call.

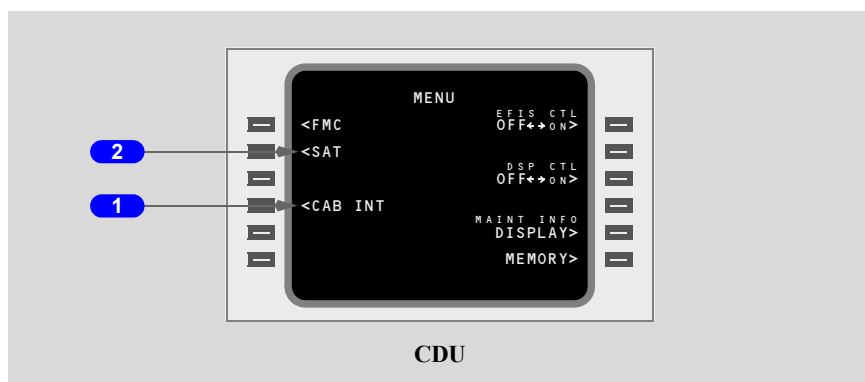
Note: The handset PA push-to-talk switch is not required to operate the handset except for PA announcements.

Note: The cabin interphone system provides access to voice gate link (if installed at the gate). Gate link allows phone calls to and from the flight deck while the airplane is at the gate.

CDU Menu Page

Pushing the CDU MENU key displays the CDU menu page.

Normally, the cabin interphone (CAB INT) and SATCOM (SAT) displays are viewed on the center CDU. The SATCOM prompt is available on all CDUs.



1 CAB INT

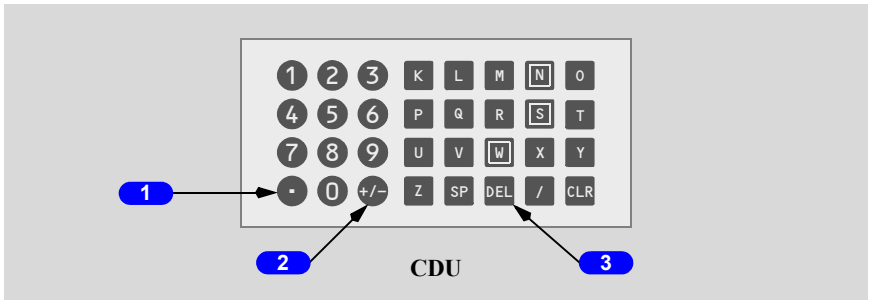
Push – displays the CDU cabin interphone pages.

Note: Available only on the center CDU.

2 SAT

Push – displays the CDU SATCOM pages.

Cabin Interphone CDU Controls



1 Period (.) key

Push – displays an asterisk (*) in the scratchpad.

2 Plus/Minus (+/-) Key

Push – displays a pound sign (#) in the cabin interphone scratchpad.

3 Delete Key

Push –

- displays DELETE in the cabin interphone scratchpad
- used to delete calls from the call queue

Cabin Interphone Main Menu

The cabin interphone menu allows the pilots to send or end calls. Calls are sent by selecting a station from the speed dial page or the directory. Two digit station codes can be manually entered into the scratchpad and the call sent using the SEND prompt. A list of the two digit station codes is located on the handset.

The directory of stations is created by the customer airline and is not shown here. The following depict typical main menu pages and selected options.

Speed Dial

The speed dial menu provides a quick means to call up to five predefined stations or groups of stations. A single push initiates the selected call.

Call Queue

When the flight deck is involved in a call, additional incoming calls are displayed in the queue. Up to four calls can be displayed in order of the priority assigned as follows:

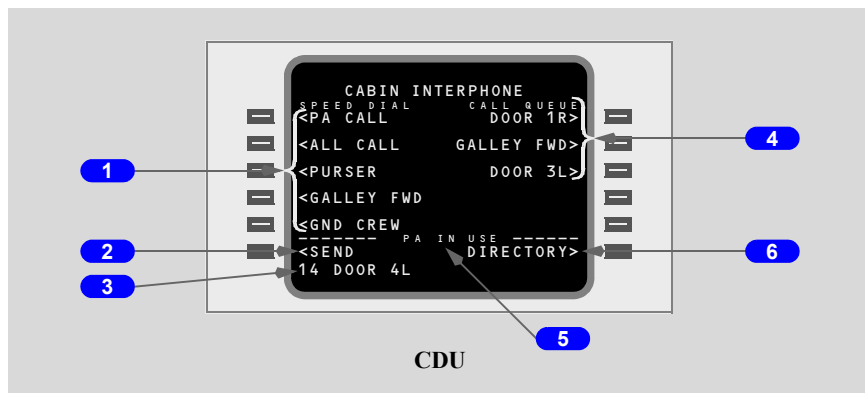
- PILOT ALERT
- conference calls

- cabin calls
- other calls

The PILOT ALERT queue entry is displayed only when the flight deck is using the PA and an incoming call is received.

When there are four calls in the queue and a new, higher priority call is received, the lowest priority call is removed from the queue and the new call is displayed in the proper priority.

Cabin Interphone Main Menu Page [Typical]



1 SPEED DIAL Labels

Lists the dial code labels of predefined stations, station groups, or functions:

- PA CALL – selects the passenger address system
- ALL CALL – selects all cabin interphone stations
- PURSER – selects the purser station
- GALLEY FWD – selects the forward galley station
- GND CREW – activates an alert horn in the nose wheel well. When selected, the horn sounds briefly to alert the ground crew for communications with the flight crew

Push – directly dials the selected station, station group or enables the selected call function.

2 SEND

A two-digit dial code may be manually entered with the CDU keyboard. If the dial code is valid, the dial code, dial code label, and SEND are displayed. If the dial code is invalid, INVALID CODE is displayed in the scratchpad.

Push – initiates a call to the selected station.

2 END CALL

Displayed during a connect call.

Push – disconnects all existing call connections.

3 CURRENT CALL

Displays the most recently selected dial code and label when a call is being connected. Dial code is removed when call is established.

Note: XX BUSY appears in the scratchpad when a cabin interphone call is attempted from the CDU to a handset that is off the hook. Line selecting <END CALL will remove the XX BUSY annunciation.

4 CALL QUEUE Labels

Lists the dial code labels of unanswered calls to the flight deck.

Push –

- initiates a call back to the displayed station(s)
- adds station(s) to the existing call (if the flight deck is currently connected in a call)

5 IN USE Status

PA IN USE –

- a portion of the airplane PA system is in use, or
- both the PA and video entertainment systems are in use

VIDEO IN USE – a portion of the video entertainment system is in use.

Blank (dashes) – neither the PA or video system is in use.

6 DIRECTORY

Push – displays the cabin interphone DIRECTORY page.

Cabin Interphone Directory Page [Typical]

The cabin interphone directory pages are used to access subdirectory pages. CDU cabin interphone directory pages and individual directory entries are predefined by the airline. Each directory label is the name of a subdirectory where the dial code labels of the individual stations or functions are listed.

Selection of the specific location(s) is accomplished on the subdirectory page.



1 Directories

Up to 20 subdirectories can be predefined.

Push – displays the appropriate subdirectory page

2 CAB INT

Push – returns the display to the cabin interphone main menu page.

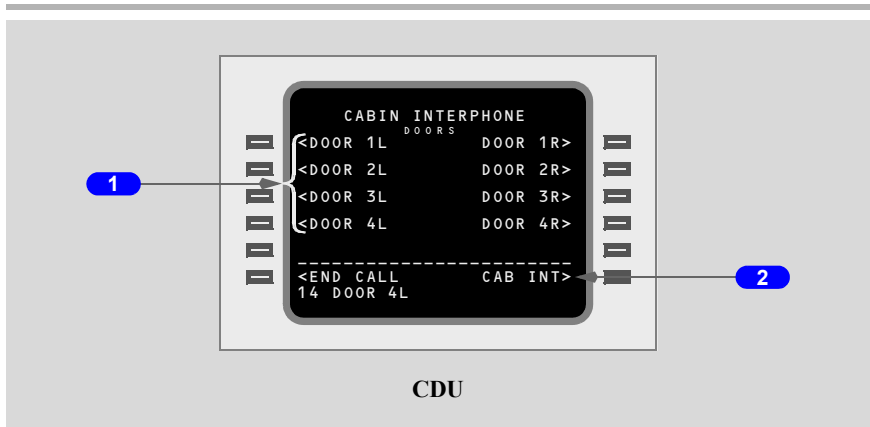
Cabin Interphone Subdirectory Page [Typical]

Selecting a dial code label on the subdirectory page initiates a call to that station or station group.

The cabin interphone subdirectory pages are used to view and select individual locations through their dial code labels.

Typical stations or station groups are:

- individual cabin station
- two or more cabin stations for conference calls
- PA call to all cabin areas
- PA call to individual cabin areas
- PA priority call to all cabin areas
- ground crew alert
- gate station (on the ground)

**1 Dial Code Labels**

Push – initiates a call to the appropriate station(s).

2 CAB INT

Push – returns the display to the cabin interphone main menu page.

Cabin Interphone System

[Freighter]

The cabin interphone system provides voice communications between flight deck, crew rest, and supernumerary stations. Boom microphones, oxygen mask microphones, and hand microphones are used by selecting the CAB transmitter select switch on an audio control panel and pushing the mic/interphone switch to the MIC position. A call is initiated from the call panel to alert the desired station to pick up the call.

The cabin interphone can be connected to the cargo interphone with the CARGO AUDIO switch on the call panel. An incoming cargo call or pushing the CARGO call switch on the call panel automatically selects cargo audio. The CARGO AUDIO switch should be disconnected following a cargo call to eliminate residual circuit noise on the cabin interphone.

EICAS communication messages and chimes alert the pilots to incoming cabin/cargo calls. Calls made to the flight deck from any crew rest, supernumerary, or cargo area illuminate the CALL light on the CAB transmitter select switch and display the associated EICAS communication message. The communication message clears from EICAS when communication is established between the calling station and the flight deck. Any additional incoming calls are added to the call already in progress.

Calls are initiated by selecting the call location on the call panel. Multiple calls can be initiated simultaneously or while other calls are already in progress.

Cargo Interphone System

[Freighter]

The cargo interphone system is used for ground and in-flight communications between cargo area stations over handsets/headsets. The cargo interphone is accessed through the Loadmaster Amplifier panel handset, headset jacks at four wing inspection station call panels, and headset jacks at eight main cargo deck speaker/microphone panels. The cargo interphone system is independent of the cargo intercom speaker/microphone panels. The cargo interphone system can be connected to the cabin interphone system for communications with the flight deck, crew rest, and supernumerary areas by selecting the CARGO AUDIO switch on the flight deck call panel.

Cargo Intercom System

[Freighter]

The cargo intercom system has speaker/microphone panels located throughout the main cargo deck. The cargo intercom speaker/microphone panels are controlled by the Loadmaster Amplifier panel and are active only on the ground.

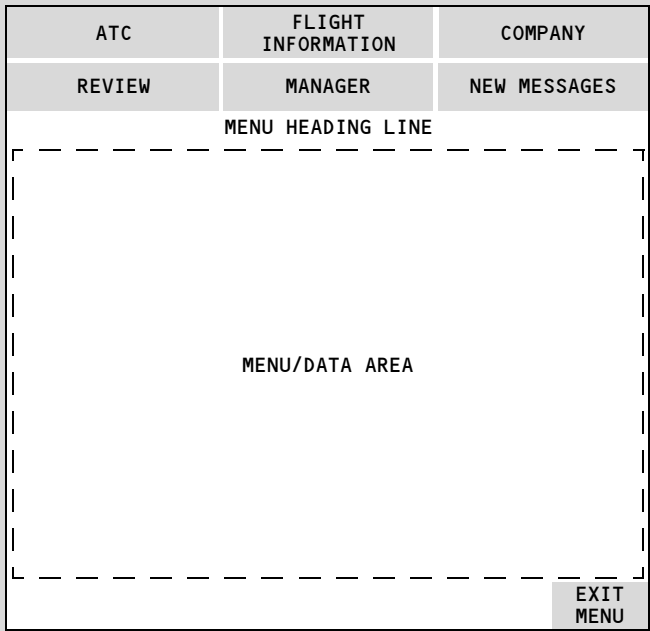
Communications**Chapter 5****MFD Communications Functions****Section 40****Introduction**

The MFD communications functions are used to control data link features. Data link messages not processed by the FMC are received, accepted, rejected, reviewed, composed, sent, and printed using communications functions on the MFD. Data link communications can be established with participating ATC and company locations. ACARS and data link radio management functions are provided through communications management menus.

The COMM display switch, located on the display select panel, displays the communications main menu on the selected MFD. Communications functions are selected using the cursor control device. Message text entry is accomplished by entering data into the CDU scratchpad and transferring it to the appropriate area. Messages can be printed on the flight deck printer. Incoming message traffic is annunciated by EICAS communications messages.

Illustrations shown in this section depict the COMM menu with all features enabled. ATC data link requires appropriate airplane and ATC capability.

Communications Menus



MFD

Note: Shown with all menu functions active.

Company communications functions can be customized by airlines. Descriptions and illustrations provided in this section are examples of a typical installation with all communications functions active (depending on airline configuration or function availability, some functions may be inhibited).

Selectable menu items (active functions) have white text on a gray background. Inhibited items have cyan text on a black background with a cyan border. Inhibited items cannot be selected. The background color for a selected top level function is green.

Selecting ATC, FLIGHT INFORMATION, COMPANY, REVIEW, MANAGER, or NEW MESSAGES selection:

- places the appropriate title in the menu heading line
- displays the subordinate menu selections for that function in the menu/data area

Subordinate menu items which lead to subsequent subordinate menu(s) are followed by three dots (...). Making a selection from the subordinate menu places the title of that function in the menu heading and displays a new subordinate menu or data below. Making a selection from the subordinate menu displays the appropriate title, the menu heading, and the data below.

ATC provides downlink messages to ATC, where available.

FLIGHT INFORMATION provides for downlink messages that allow request of Departure Clearance, Oceanic Clearance, or Automatic Terminal Information Service (ATIS) information.

COMPANY provides for downlink messages to airline facilities.

REVIEW displays a list of all transmitted messages, received messages not requiring a response, or received messages with the response already sent. REVIEW is inhibited if there are no listed messages.

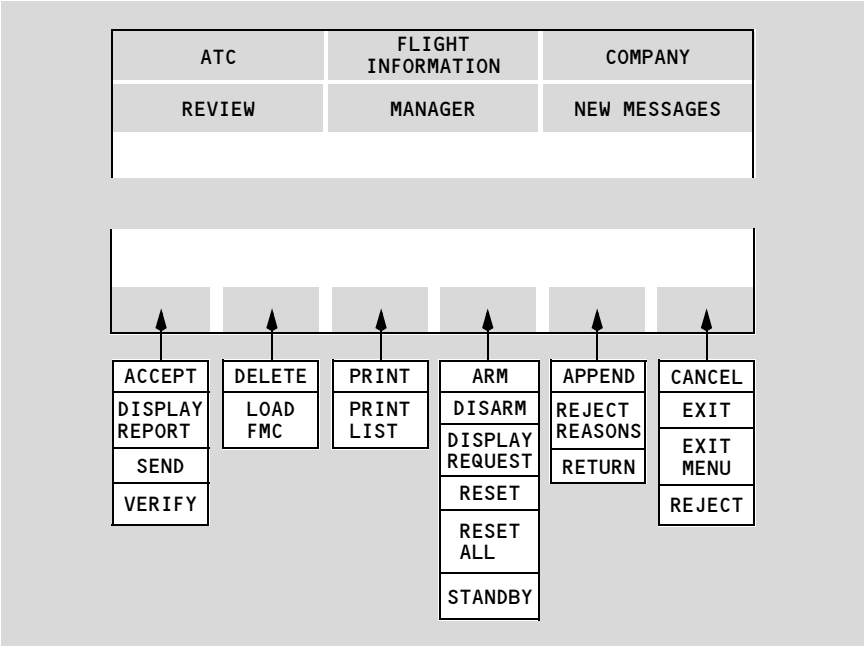
MANAGER provides the controls for data link and communications systems in general.

NEW MESSAGES displays a list of uplinked messages that have not been displayed or responded to. NEW MESSAGES is inhibited when there are no new messages.

Communications Control and Input Functions

Communications menus, controls, and data input methods are similar for ATC, FLIGHT INFORMATION, and COMPANY functions. Basic functions are explained here.

Command Key Locations



Communications command keys are displayed at the bottom of communications pages. Command keys change as appropriate for pages displayed. Each key has a label which changes based on the page displayed and the possible action. Only one label is displayed in a single location for a specific condition on the page.

Command Key Functions

The following table describes the key functions and labels for all ATC, FLIGHT INFORMATION, and COMPANY functions.

Command key label	Displayed/Inhibited	Key function
ACCEPT (uplink messages)	Displayed when: - message requires an accept/reject response, and - all message pages have been displayed Inhibited for first 2 seconds of message display	Select: - message acceptance downlinked to message sender - ACCEPT & REJECT keys removed - message status displayed in info box - CANCEL command key displayed
APPEND (company downlink accept/reject response)	Displayed when: - all pages of the uplinked message have been displayed, and - company data link capability is operational Inhibited when: - for first 2 seconds of uplink display, or - when company data link capability is not operational	Select: - uplink message is removed, and - downlinked message page is displayed
ARM (ATC downlink reports)	Displayed when an armable report is open: - REPORT LEAVING - REPORT LEVEL - REPORT PASSING - REPORT REACHING.	Select: - arms the report for automatic downlink to ATC when report conditions are met - key function changes to DISARM - report status changes from OPEN to ARMED

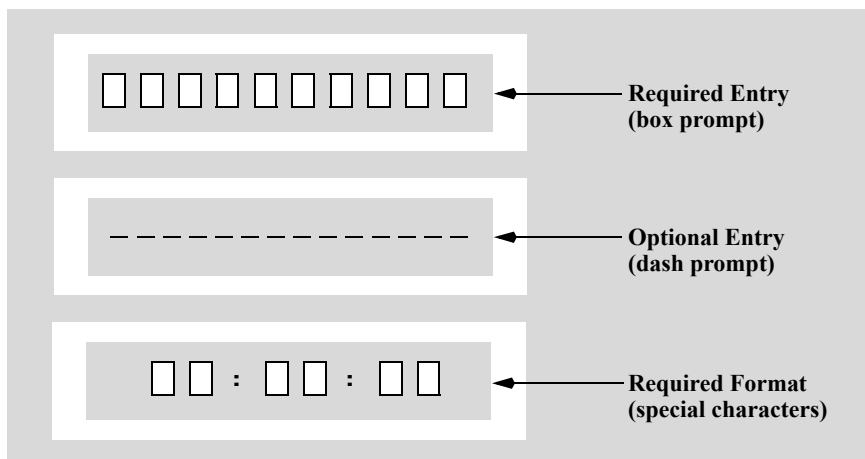
Command key label	Displayed/Inhibited	Key function
CANCEL	Displayed when: • uplink message is displayed which does not require an accept or reject response, or • an uplink message is displayed which has been accepted, rejected, or • review message is displayed Inhibited for first 2 seconds of message display.	Message is removed.
DELETE (ATC reports)	Displayed when a downlink report page is open for entry.	Select: • deletes the report without sending. • displays the COMM menu
DISARM (ATC reports)	Displayed when an armable report is ARMED: • REPORT LEAVING • REPORT LEVEL • REPORT PASSING • REPORT REACHING	Select: • disarms automatic report downlink to ATC • key function changes to ARM • Report status changes from ARMED to OPEN
DISPLAY REPORT	Displayed after accepting an uplink message which contains a report.	Displays the downlink report attached to an uplinked message.
DISPLAY REQUEST	Displayed after accepting an ATC uplink message which contains a request.	Downlink request which required an ATC response is displayed,
EXIT	Displayed when: • a downlink message is displayed, or • a manager page is displayed	COMM main menu is displayed
EXIT MENU	Displayed when menu is displayed.	COMM main menu is displayed.

777 Flight Crew Operations Manual

Command key label	Displayed/Inhibited	Key function
LOAD FMC (ATC uplink)	Displayed when uplinked ATC message contains data which can be loaded into the FMC. Inhibited when active route is in a MOD condition.	Select: • FMC data is transferred into the active route, and • FMC modification is started.
PRINT	Displayed when: • displayed message can be printed, and • printer is available Inhibited when printer is not available.	Message is sequenced for printing.
PRINT LIST	Displayed when: • new message list page is displayed, or • review list page is displayed Inhibited when printer is not available.	All messages in the list are sequenced for printing.
REJECT (uplink messages)	Displayed when: • message requires an accept/reject response, and • all message pages have been displayed Inhibited for first 2 seconds of message display.	Select: • message rejection downlinked to message sender • ACCEPT and REJECT command keys removed • CANCEL command key displayed • message status displayed in info box, and • message cleared from the display 5 seconds after status changes to REJECTED
REJECT REASONS (ATC reject downlink)	Displayed when an uplink message requires an accept or reject response.	Displays REJECT REASON page.
RESET (downlink pages)	Displayed when downlink page is displayed.	Message parameters are reset to their default values.

Command key label	Displayed/Inhibited	Key function
RESET ALL (ATC downlink pages)	Displayed when ATC VERIFY REQUEST page is displayed.	Select: - all request parameters on the VERIFY REQUEST are set to reset/default values - ATC combined request pages are reset, or - COMM main menu is displayed
RETURN	Displayed when: - a review message is displayed, or - a downlink message is displayed, or - a VERIFY REQUEST page is displayed, or - a manager page is displayed	Previous list page, request page, or menu is displayed.
SEND (downlink messages)	Displayed when: - required data complete, and - all company message pages have been displayed Inhibited when transmission queue is full.	Select: - message transmission initiated - message status displayed in info box, and - message cleared from the display 5 seconds after status changes to SENT
STANDBY (ATC uplink messages)	Displayed when: - uplinked message is received which requires an accept/reject response, and - STANDBY has not been previously selected for this message	Standby response is sent.
VERIFY	Displayed when data is entered on more than one of the following ATC pages: - ALTITUDE REQUEST - ROUTE REQUEST - SPEED REQUEST	Displays VERIFY REQUEST page.

Text Entry



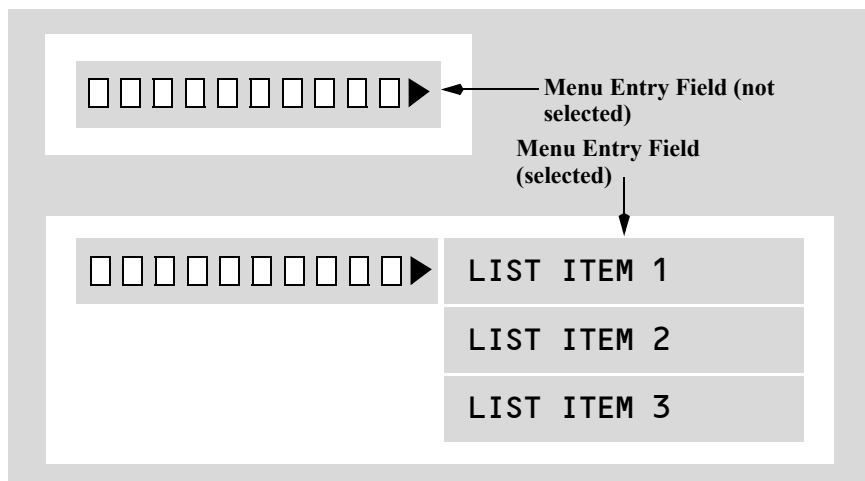
Downlink message pages provide text entry fields. Scratchpad entries transfer to selected entry fields when a cursor select switch is pushed. Scratchpad entries blank when successfully transferred. Scratchpad entries remain and an INVALID ENTRY message is displayed on the MFD when the entry is not valid.

An entry field resets to a default value when a blank scratchpad is transferred. An entry field blanks when a space is transferred. An entry field resets to the default entry prompt when DELETE is transferred.

Box and dash prompts indicate the maximum number of characters allowed.

Some entry fields have format requirements. Entry prompts display the required entry format, with special characters separating entry boxes. The required data is entered without the special characters or spaces. Scratchpad data is transferred to entry boxes after being checked for proper format. Invalid data or format prevents transfer and displays an INVALID ENTRY message.

Menu Entry Fields



Menu entry fields are used to make text entry selections from a list. Menu entry fields distinguish mandatory versus optional entry in the same manner as CDU entry field.

The menu entry field is distinguished from other entry fields by the pointer to the right of the field.

When initially selected, a list of menu items is displayed to the side of the pointer. If an item from the list is then selected using the cursor and cursor select switch, that item is transferred to the entry field. If the menu prompt is selected again and the CDU contains a valid value, that CDU value is transferred to the entry field. Actions for invalid values, an empty scratchpad, space characters, and the delete key are the same as for the CDU entry field. When the entry field is selected with text already inserted, the menu list is removed from the display.

Invalid Entries

When the scratchpad contains invalid data for the entry field, the INVALID ENTRY message is displayed in the INFO BOX. Re-entering valid data clears the INVALID ENTRY message on an ATC downlink page. Selecting the EXIT INFO key also clears the INVALID ENTRY message and removes the info box.

INVALID ENTRY messages on a company downlink page must be individually cleared by selecting the EXIT INFO key before valid data is re-entered into the field.

Message List

Message titles and related information can be displayed in a list. The illustration shows the REVIEW message list. A similar list is available for NEW MESSAGES.

The NEW MESSAGE list is sorted by the time of receipt, the most current message at the top. ATC uplink messages have an ATC label to the right of the message block. The message remains in the list until it is accepted, rejected, or displayed. Messages requiring an accept/reject remain in the list until the accept/reject response is accomplished.

Selecting an item from the list with the cursor and pushing the cursor select switch displays the message page. Lists are also used to view new messages.

ATC		FLIGHT INFORMATION		COMPANY		
REVIEW		MANAGER		NEW MESSAGES		
1	1848Z	RECEIVED				3
	1842Z	VHF-VOICE CONTACT		ACCEPTED		
2	1832Z	WEATHER		DISPLAYED		4
	1820Z	ATIS		DISPLAYED		

1 Current Time

Displays current time.

2 Message Time

For new messages – time the message is received.

For review messages – time the message is received or sent.

3 Message Title

Displays message title information.

4 Message Status

Only displayed for review list boxes.

The appropriate status indicator is displayed.

Message Display Format

A typical message display format is shown. Messages selected from a list are displayed in this format.

Note: Selection of a main menu item exits the message page.

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1 1233Z	GATE INFORMATION	3 ACCEPTED
2	Flight: XX127 Gate: B1 ETA: 1245Z	4

1 Message Time

For downlink messages – current time.

For new messages – time the message is received.

For review messages – time the message is received or sent.

2 Message Title

Displays message title information.

3 Review State

Only displayed for review messages.

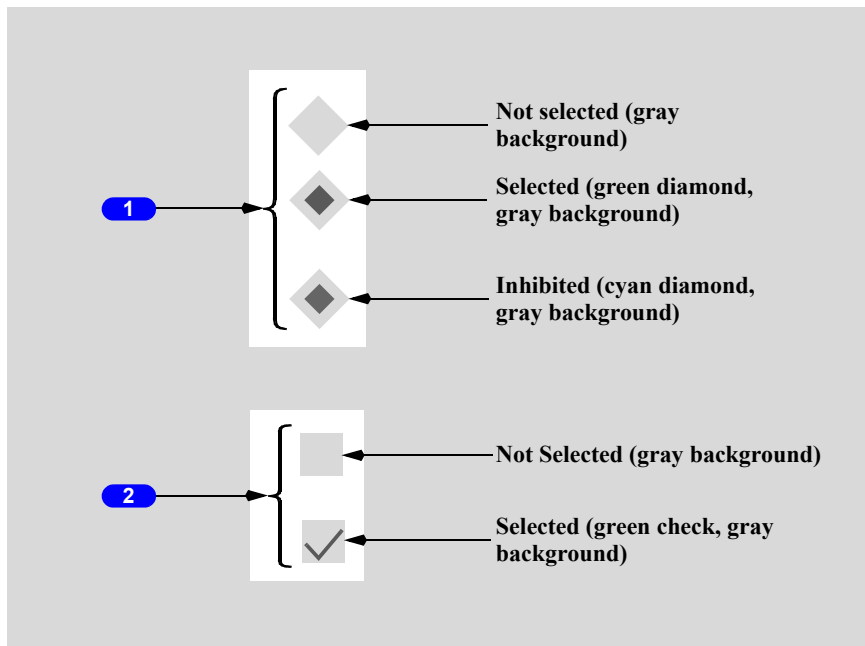
The appropriate state indicator is displayed.

4 Message Content

Located between the title and the keys.

Exclusive and Nonexclusive Select Keys

Manager and new message pages can contain select keys to activate features. Pushing the cursor select switch when the key is highlighted makes the selection. A second selection of a nonexclusive key toggles to the deselected state.



1 Exclusive Select Key

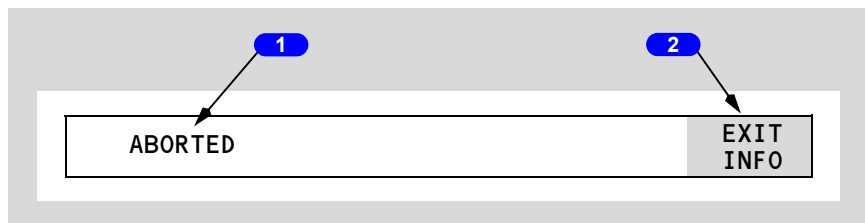
The diamond-shaped exclusive select keys are used to select a single feature from a group. Selecting a key activates the feature and all other exclusive select keys in that group are deselected. The keys are displayed in their selected or default condition. If selection is required, the SEND key is not displayed until a selection is made.

2 Nonexclusive Select Key

The square-shaped nonexclusive select keys are used to select multiple features. Selecting a key activates the feature. The keys are displayed in their previously selected or default condition. If selection is required, the SEND key is not displayed until a selection is made.

Information Messages

Messages are displayed in an information box at the bottom of the MFD. The information box covers command keys. Information messages, such as INVALID ENTRY, are cleared by selecting EXIT INFO. Some information messages automatically disappear.



1 Information Message Text

The text starts at the left of the box.

2 EXIT INFO Key

Select – removes the information box for the displayed message from the display.

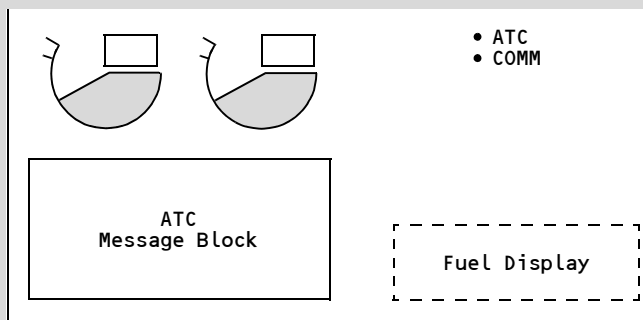
Communications Information Messages

Communications information messages are described in the following table.

Information Message	Condition
ABORTED	ATC connection not established, lost, or loss of handoff to a new active center, while a message is transmitting, or before acceptance.
ACCEPTED	ACCEPT response received.
ACCEPTING	ACCEPT response sent.
DISPLAYED	All pages of a message not requiring an ACCEPT or REJECT response have been displayed.
COMM CONTROL TRANSITION – COMPANY MESSAGES LOST	Airplane data link system switched to a new AIMS master. Company datalink information may be lost. Incomplete company downlink messages are lost and must be created/transmitted again. If previously received Company messages are required, they must be requested again. ATC connections, data, and messages are not affected.
INCOMPLETE MESSAGE	Only part of the displayed message is received.

777 Flight Crew Operations Manual

Information Message	Condition
INVALID ENTRY	An entry box is selected and the CDU scratchpad value is not valid.
LOADING	ATC uplink route modification is loading into the FMC.
MESSAGE TO PRINTER	Selected message(s) sent to printer.
NO ACCEPT (company)	ACCEPT response is not successfully transmitted or an ACCEPT response is not required.
NO PRINT	An attempt to send a message(s) to the printer is unsuccessful.
NO REJECT (company)	REJECT response is not successfully transmitted or a REJECT response is not required by the message.
NO SEND	An attempt to send a downlink message is unsuccessful.
PRINTING	ATC message is printing.
REJECTED	REJECT response received.
REJECTING	REJECT response transmitting.
SENDING	The downlink message is sent.
SENT	The downlink message is received.
UNABLE TO LOAD	ATC uplink route modification can not be loaded into the FMC.

Uplink Message**EICAS**

ATC Uplinks

Arriving ATC uplink messages are annunciated by an •ATC communications message, an aural chime, and the display of the EICAS ATC message block. The message text is displayed below the normal EICAS engine display. Uplink messages too large to fit in the message area display the message LARGE ATC MESSAGE. The message text is displayed using the NEW MESSAGE menu selection.

Flight Information Uplinks

Arriving flight information uplink messages are annunciated by a •COMM communications message. The message text is displayed using the NEW MESSAGE menu selection.

Company Uplinks

Arriving company uplink messages are annunciated by a •COMM communications message and an optional aural chime.

Accept/Reject Uplinks

ATC messages requiring an accept or reject response display those options on the EICAS display. The MFD message page displays ACCEPT, STANDBY, REJECT REASONS, and REJECT keys at the bottom. Select ACCEPT or REJECT to respond to the uplink message. The REJECT REASONS key can be selected to inform ATC why the message is being rejected.

Company messages can also be accepted or rejected on the message page.

After making a selection, the status changes to ACCEPTING/REJECTING while the response is transmitting. When the communications network sends a response indicating that the message was received, the message status changes to ACCEPTED/REJECTED. After a message has been accepted or rejected, a CANCEL key is displayed at the bottom of the page. Selecting CANCEL will clear the message from the display. Rejected messages are automatically removed 5 seconds after the message status changes to REJECTED.

The ACCEPT, CANCEL, and REJECT buttons on the glareshield perform the same function as the same keys on the MFD.

Reject Reasons Page

ATC

REVIEW

FLIGHT INFORMATION

MANAGER

COMPANY

NEW MESSAGES

1234Z

REJECT REASONS

DUE TO AIRCRAFT PERFORMANCE

DUE TO WEATHER

NOT CONSISTENT, PLEASE RE-SEND

FREE TEXT:

RESET

RETURN

REJECT

If the response to an ATC uplink message is to reject the message, the REJECT REASONS key can be selected to inform ATC why the clearance message is being rejected. Up to three lines of text can be included. Select REJECT to send the reject message with the applicable reasons.

Standby Response

When more time is required to respond to an ATC uplink, use the STANDBY key to send a delay notification.

ATC Sidelinks

ATC sidelink messages are annunciated by an •ATC communications message, an aural chime, and the display of the EICAS ATC message block. The message text is displayed below the normal EICAS engine display. Selecting CANCEL with the cursor control device or glareshield button will clear the message from the display.

ATC Data Link

ATC data link communicates with participating air traffic control centers, reducing the need for VHF voice communications. Airplane situation reports, route changes, speed and vertical clearances, and voice contact requests can be sent or received as appropriate. The COMM display ATC menu selection allows display of downlink message pages.

Uplink and downlink messages are stored. All messages are assigned the time of receipt/transmission and are printable.

ATC data link requires manual logon to a participating ATC facility. Once logged on, transfer to adjacent ATC facilities is normally automatic.

Crew Feedback

ATC uplinks containing clearance data that the crew can set on the MCP or EFIS control panel have a crew feedback display function. When the message is displayed on EICAS or the message page, the data values change from white to green when properly set by the crew. Data which provides feedback is:

- MCP speed
- MCP heading
- MCP altitude
- barometer setting
- transponder code
- VHF frequency
- HF frequency

FMC Data Loading

Some ATC uplinks contain data for loading into the FMC. Display of the LOAD FMC command key indicates that FMC data is available for loading. Selecting LOAD FMC transfers data to the FMC and creates an FMC modification.

Both MFD information messages and FMC scratchpad messages provide indications of loading progress.

Downlink Pages

ATC Menu

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
ATC		
ALTITUDE REQUEST	WHEN CAN WE EXPECT	EMERGENCY REPORT
ROUTE REQUEST	VOICE CONTACT REQUEST	ATC REQUESTED REPORTS...
SPEED REQUEST	LOGON / STATUS	POSITION REPORT
CLEARANCE REQUEST		FREE TEXT MESSAGE

ATC Menu

The ATC menu provides access to ATC downlink pages.

The ATC REQUESTED REPORTS menu selection is inhibited (cyan) when no reports are requested by ATC.

Note: This menu is not repeated when describing individual pages.

Altitude Request

The ALTITUDE REQUEST page allows selection of an altitude, an altitude block, or a VMC descent. A second request page allows selection of a reason for the request.

ATC		FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES	
1234Z		ALTITUDE REQUEST	
1	ALTITUDE: ---- STEP AT: ----- CRUISE CLIMB	1	
2	BLOCK: ---- TO: ----	2	
3	REQUEST VMC DESCENT		
SEND PRINT RESET RETURN EXIT			

1 ALTITUDE

The requested altitude is entered into the dash prompt and the SEND key becomes active.

Pushing the SEND key requests a normal climb at climb power unless otherwise requested, or a normal descent.

Additional climb or descent options are:

- STEP AT – allows entering a time or position for the start of the climb or descent
- CRUISE CLIMB – begin a cruise climb from present position

STEP AT is inhibited when the ALTITUDE value is less than 150 feet from current airplane altitude. Altitude entries are any valid FMC altitude. Time entries are in four digit, hours and minutes, optionally followed by a Z. Position entries are any valid FMC position.

2 BLOCK

BLOCK is the beginning of a block altitude. TO is the end of the altitude block. Altitude entries are any valid FMC altitude.

The SEND key becomes active with an entry.

3 REQUEST VMC DESCENT

A VMC descent is begun from present position.

The SEND key becomes active with this selection.

Altitude Request Reason Page

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z ALTITUDE REQUEST		
☐ AT PILOTS DISCRETION ☐ DUE TO WEATHER ☐ DUE TO AIRCRAFT PERFORMANCE ☐ MAINTAIN OWN SEPARATION AND VMC		
FREE TEXT:		
SEND	PRINT	RESET
RETURN	EXIT	

The page scroll bar selects a second ALTITUDE REQUEST page. Reasons for a request are optionally entered on this page. Up to three lines of free text can be included.

Route Request

The ROUTE REQUEST page allows selection of a direct to waypoint, new route, heading or track, departure and transition, arrival and transition, weather deviation, or a route offset. A second request page allows selection of a reason for the request.

ATC		FLIGHT INFORMATION		COMPANY	
REVIEW		MANAGER		NEW MESSAGES	
1234Z		ROUTE REQUEST			
1	DIRECT TO: _____				
2	ROUTE 1	ROUTE 2			
3	HEADING: ---				
4	TRACK: ---				
5	DEP/ARR: -----				
6	WEATHER DEVIATION UP TO: -----NM				
7	OFFSET: ---NM				
8	OFFSET AT: -----				
SEND		PRINT	RESET	RETURN	EXIT

1 DIRECT TO

Enter any valid FMC waypoint. The SEND key becomes active with this selection.

2 ROUTE

Selects FMC route 1 or 2. Sends the selected route, including any modifications. The SEND key becomes active with this selection.

3 HEADING

Enter desired heading. When displays are referenced to true north, a TRU label is displayed right of the heading. The SEND key becomes active with this selection.

4 TRACK

Enter desired ground track. When displays are referenced to true north, a TRU label is displayed right of the ground track. The SEND key becomes active with this selection.

5 DEP/ARR

Enter one of the following:

- departure
- arrival
- departure and transition
- arrival and transition

Default entries are:

- departure procedure/transition selected for the selected route
- the approach procedure/transition selected for the active route when the airplane is in the air and an arrival procedure/transition is not selected

The SEND key becomes active when one of the check boxes is selected.

6 WEATHER DEVIATION UP TO

Enter desired offset in nautical miles. Valid entries are L, R, or no prefix (either side) and NNN (NNN is any number from 1 to 128). The SEND key becomes active with this selection.

7 OFFSET

Enter desired FMC route offset in nautical miles. Valid entries are L or R XX (XX is any number from 1 to 99). The SEND key becomes active with this selection.

8 OFFSET AT

Enter a time or position to begin the offset. Time entries are in four digit, hours and minutes, optionally followed by a Z. Position entries are any valid FMC position.

Route Request Reason Page

The page scroll bar selects a second ROUTE REQUEST page similar to the ALTITUDE REQUEST page previously described. The reasons for a request are optionally entered on this page. Up to three lines of free text can be included.

Speed Request

The SPEED REQUEST page allows selection of speed. A second request page allows selection of a reason for the request.

ATC		FLIGHT INFORMATION		COMPANY	
REVIEW		MANAGER		NEW MESSAGES	
1234Z		SPEED REQUEST			
1 SPEED: ---				1	
				2	
SEND		PRINT		RESET	
		RETURN		EXIT	

1 SPEED

Enter any valid FMC speed or mach number. IAS entries are rounded to the nearest 10 knots. The SEND key becomes active with this entry.

Speed Request Reason Page

The page scroll bar selects a second SPEED REQUEST page similar to the ALTITUDE REQUEST page previously described. The reasons for a request are optionally entered on this page. Up to three lines of free text can be included.

Clearance Request

ATC	FLIGHT INFORMATION	COMPANY		
REVIEW	MANAGER	NEW MESSAGES		
1234Z		CLEARANCE REQUEST		
REQUEST CLEARANCE				
FREE TEXT:				
SEND	PRINT	RESET	RETURN	EXIT

Selecting REQUEST CLEARANCE informs ATC that the crew is ready for a clearance, such as predeparture or pushback. Up to three lines of free text can be included. The SEND key becomes active with this selection.

Combination Downlink Request

ATC	FLIGHT INFORMATION	COMPANY		
REVIEW	MANAGER	NEW MESSAGES		
1234Z ALTITUDE REQUEST				
ALTITUDE: FL330		1		
STEP AT: _____				
CRUISE CLIMB				
SEND	PRINT	RESET	RETURN	EXIT

1234Z SPEED REQUEST				
SPEED: .84		1		
VERIFY	PRINT	RESET	RETURN	EXIT

1234Z VERIFY REQUEST				
REQUEST CRUISE CLIMB TO FL 330, REQUEST SPEED .84				
SEND	PRINT	RESET	RETURN	EXIT

Requests from the altitude, speed, and route pages can be combined into one downlink request. Each request is individually selected and filled out. Select subsequent request pages by selecting RETURN, and selecting additional downlink pages from the ATC main menu. When data is entered into the second request page, the SEND key changes to VERIFY.

The SEND key is active on the VERIFY REQUEST page. A combined request is limited to five elements. Selecting a sixth request element displays the MESSAGE LIMIT EXCEEDED information message.

777 Flight Crew Operations Manual

The verify page provides a display of the combined request elements. Each element is displayed on separate lines. Elements requiring revision before sending are revised on their respective request page. Selecting SEND transmits the combined downlink message to ATC.

The example shows a combined altitude and speed request. The altitude request is created first.

When Can We Expect

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z WHEN CAN WE EXPECT		
☐ ALTITUDE: ----		
☐ CRUISE CLIMB		
☐ HIGHER ALT		
☐ LOWER ALT:		
☐ SPEED: ----		
☐ BACK ON ROUTE		
FREE TEXT: ----- ----- -----		
SEND	PRINT	RESET RETURN EXIT

Making selections asks ATC the time or location the crew can expect clearance for the requested items. Altitude, speed, and cruise climb entry rules are the same as on the ALTITUDE REQUEST and SPEED REQUEST pages. Up to three lines of free text can be included. The SEND key becomes active when a check box is selected.

Voice Contact Request

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z VOICE CONTACT REQUEST		
☐ REQUEST VOICE CONTACT		
FREE TEXT:		
SEND	PRINT	RESET
	RETURN	EXIT

Making selection asks ATC for a voice contact. Up to three lines of free text can be included. The SEND key becomes active when the request for voice contact box is selected.

ATC Logon/Status

The ATC LOGON/STATUS page allows entry of the desired ATC facility for establishment of a data link connection.

777 Flight Crew Operations Manual

The SEND key is displayed after all logon entries are completed. Selecting the SEND key displays SENDING status during logon transmission. Five seconds after the logon status changes to SENT, the page is exited.

[AIMS V14]

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z ATC LOGON/STATUS		
ACTIVE CENTER:		
NEXT CENTER:		
ATC CONNECTION: NOT ESTABLISHED		
MAX UPLINK DELAY: 360 SEC		
LOGON TO: KOAK		
FLIGHT NUMBER: BOE456		
TAIL NUMBER: N7771		
SEND	RESET	RETURN EXIT

1 ACTIVE CENTER

Displays the ATC facility identifier where a connection is established.

2 NEXT CENTER

Displays the ATC facility identifier to which an automatic handoff transfers the connection.

3 ATC CONNECTION

Displays the status of the ATC connection, ESTABLISHED or NOT ESTABLISHED.

4 LOGON TO

Box prompts are initially displayed. Enter the ICAO four letter identifier for the desired ATC center. The display changes to dashed prompts after establishing an ATC connection.

5 FLIGHT NUMBER

Normally displays the flight number entered on the FMC route page. When the flight number is not available, box prompts are displayed. Flight number entry on this page is copied to the FMC route page. Changing this entry after establishing an ATC connection cancels the ATC connection.

6 TAIL NUMBER

Normally supplied by the airplane system once it has been manually entered, unless battery power to AIMS is interrupted. When the airplane tail number (registry number) is not available to the system, box prompts are displayed. Changing this entry after establishing an ATC connection cancels the ATC connection. Tail number is provided on the SELCAL placard.

8 MAX UPLINK DELAY

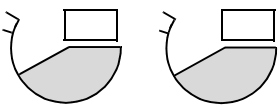
[AIMS BP 2005]

Elapsed time from transmission to receipt of an ATC uplink message that triggers a late annunciation. The words “UPLINK DELAY EXCEEDED” precede any late ATC uplink message. Valid entries are from 1 to 999. Resets to off and displays dashes at:

- power-up
- datalink system reset
- ATC connection terminated
- “DELETE” entry

ATC Connection Displays

[AIMS V14]



• ATC

ATC COMM ESTABLISHED
WITH KOAK
1234Z CANCEL

Fuel Display

EICAS

REVIEW	MANAGER	NEW MESSAGES
1234Z	ATC LOGON/STATUS	
ACTIVE CENTER: KOAK		
NEXT CENTER:		
ATC CONNECTION: ESTABLISHED		
MAX UPLINK DELAY: 360 SEC		
LOGON TO: ----		
FLIGHT NUMBER: B0E456		
TAIL NUMBER: N7771		
1	☒ ATC DATA LINK OFF	
☐ CONFIRM OFF		2
RESET RETURN EXIT		

MFD

1 ATC DATA LINK OFF

Displayed when an ATC connection is established.

Selecting ATC DATA LINK OFF displays the CONFIRM OFF selection.

2 CONFIRM OFF

Selecting CONFIRM OFF sends the termination request.

The EICAS communication message •ATC is displayed when the connection is terminated.

Loss of ATC Connection

If the EICAS alert message DATALINK LOST is displayed for 16 minutes, the ATC connection is automatically lost and the EICAS communication message •ATC is displayed

Once an ATC connection is terminated or lost, the logon entries revert to the default values.

Emergency Report

This page informs ATC of an emergency. Sending this report places automatic dependant surveillance (ADS) into the emergency mode.

	ATC	FLIGHT INFORMATION	COMPANY
	REVIEW	MANAGER	NEW MESSAGES
	1234Z	EMERGENCY REPORT	
1	☐ MAYDAY	☐ PAN	☐ CANCEL EMERGENCY
2	☐ DIVERTING TO:	VIA ROUTE X	
3	☐ FUEL REMAINING		
4		HOURS+MINUTES	
5	☐ SOULS ON BOARD:		
6	☐ DESCENDING TO:		
7	☐ OFFSETTING:		
8	☐ FREE TEXT:		
	SEND	PRINT	RESET
		RETURN	EXIT

1 MAYDAY, PAN, CANCEL EMERGENCY

Select MAYDAY or PAN emergency. The SEND key becomes active. CANCEL EMERGENCY informs ATC that a previous emergency is now canceled and returns ADS to the normal mode. CANCEL EMERGENCY is inhibited until MAYDAY or PAN downlink is sent.

2 DIVERTING TO

Defaults to the destination airport from the active route. The default route number is displayed. Enter any valid FMC position.

3 FUEL REMAINING

Displays the FMC fuel remaining from the PROGRESS page.

4 FUEL REMAINING – HOURS + MINUTES

Defaults to time provided from the FMC. Manually enter fuel remaining in hours and minutes. Use two numeric characters for hours followed by two numeric characters for minutes.

5 SOULS ON BOARD

Manual entry of number of souls on board is required. Enter up to three numeric characters.

6 DESCENDING TO

Enter the altitude for an immediate descent. The default value is the MCP altitude when it is more than 150 feet below current altitude.

7 OFFSETTING

Enter any valid FMC route offset value.

8 FREE TEXT

24 characters of free text can be included.

Note: When data is entered in all fields above OFFSETTING, the system will not accept data entry for the OFFSETTING and FREE TEXT fields. Entering data in one of these two fields displays the MESSAGE LIMIT EXCEEDED information message.

ATC Reports

ATC Requested Report

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1230Z ATC UPLINK		
CLIMB TO AND MAINTAIN FL330, REPORT REACHING FL330.		

DISPLAY REPORT	CANCEL
-------------------	--------

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
ATC REPORT		
REACHING FL330		

SEND	DELETE	PRINT	ARM	RETURN	CANCEL
------	--------	-------	-----	--------	--------

ATC uplink messages can contain a request for a report. When the uplink is accepted, the DISPLAY REPORT key is displayed. Selecting DISPLAY REPORT displays the ATC requested report. A displayed report can be sent. Some reports can be armed for automatic transmission when conditions are met.

Armable Report

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
ATC		
ALTITUDE REQUEST	WHEN CAN WE EXPECT	EMERGENCY REPORT
ROUTE REQUEST	VOICE CONTACT REQUEST	ATC REQUESTED REPORTS...
SPEED REQUEST	LOGON / STATUS	POSITION REPORT
CLEARANCE REQUEST		FREE TEXT MESSAGE

ATC REPORT	ARMED
LEAVING FL330	

ATC REPORT	ARMED
LEVEL FL330	

ATC REPORT	ARMED
PASSING SEA	

ATC REPORT	ARMED
REACHING FL330	

All reports requested by ATC can be displayed using the ATC REQUESTED REPORT menu selection. The LEAVING, LEVEL, PASSING, and REACHING reports can be armed for automatic transmission. Selecting the ARM key for a report displays ARMED for the report status. When a report is armed, the ARM key changes to DISARM. When a report is automatically transmitted, an ATC uplink message confirms the report was sent.

Position Report

Use the POSITION REPORT page to manually send a position report.

ATC		FLIGHT INFORMATION		COMPANY	
REVIEW		MANAGER		NEW MESSAGES	
POSITION REPORT					
1	POS: 4038.2N12045.1E	ATA: 1234Z		7	
2	ALTITUDE: 32000 FT		1		
3	EST: 4038.4N13045.3E	ETA: 1314Z		8	
4	NEXT: 4038.6N14045.8E				
		DEST ETA: 2200Z	2	9	
5	SPEED: .89	TEMP: -52C		10	
6	POS FUEL: xxx.xx X 1000	WIND: 145/030 KT		11	
SEND		PRINT	RESET	RETURN	EXIT

1 POS

Displays the last sequenced FMC waypoint. Displays all asterisks (*) when no FMC data is available.

Latitude and longitude are displayed in the same order as the FMC position report page. Degree and minute values precede the compass letter, just as the crew uses in a voice report.

2 ALTITUDE

Displays current altitude.

3 EST

Displays the next FMC waypoint. Accepts any valid FMC waypoint entry. Requires manual entry for ATC reporting position which is not a route waypoint.

4 NEXT

Displays the next FMC waypoint following EST waypoint. Accepts any valid FMC waypoint entry. Requires manual entry for ATC reporting position which is not a route waypoint.

5 SPEED

Displays the current FMC speed. Accepts valid speed entry. Displays all asterisks (*) when no FMC data is available.

6 POS FUEL

Displays FMC calculated fuel remaining at the POS waypoint. Displays all asterisks (*) when no FMC data is available.

7 ATA

Displays actual time of arrival at the last sequenced FMC waypoint. Displays all asterisks (*) when no FMC data is available.

8 ETA

Displays estimated time of arrival for the next FMC waypoint. Accepts valid time entry.

9 DEST ETA

Displays estimated time of arrival for the last FMC waypoint. Accepts a valid time entry. Displays all asterisks (*) when no FMC data is available.

10 TEMP

Displays current air temperature. Displays all asterisks (*) when no FMC data is available.

11 WIND

Displays current wind bearing and speed. Displays all asterisks (*) when no FMC data is available.

Optional Position Report Items

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
POSITION REPORT		
TURBULENCE: ☐ LIGHT ☐ MODERATE ☐ SEVERE		ICING: ☐ TRACE ☐ LIGHT ☐ MODERATE ☐ SEVERE
		▲ 1 2 ▽
SEND	PRINT	RESET
		RETURN
		EXIT

A report of current turbulence and icing conditions can be included with the position report.

Nine lines of text can be transmitted.

Flight Information

Flight Information Menu

FLIGHT INFORMATION Menu

The Flight Information menu provides access to FLIGHT INFORMATION downlink pages.

Departure Clearance Request

The DEPARTURE CLEARANCE REQUEST page allows request downlinks to obtain clearance via datalink in a more timely manner with reduced risk of incorrect voice transmission. The clearance may be viewed on the MFD or printed.

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z DEPARTURE CLEARANCE REQUEST		
1 → FLT NUMBER: □□□□□□□	FACILITY: □□□□ ← 4	
2 → DEPARTURE: □□□□	DESTINATION: □□□□ ← 5	
3 → ATIS: □	GATE: □□□□ ← 6	
FREE TEXT: ----- ----- -----		
SEND	PRINT	RESET RETURN EXIT

1 FLIGHT NUMBER

Flight number defaults to FMC flight number, if entered. If previously entered and flight number is more than 7 characters, only the first 7 characters display.

When boxes display, valid entry is flight number up to 7 characters.

2 DEPARTURE

Departure airport defaults to FMC origin.

Valid entry is a valid ICAO identifier.

3 ATIS

Valid entry is any character A through Z.

4 FACILITY

Valid entry is a 4 character ATC facility identifier.

5 DESTINATION

Destination airport defaults to FMC destination.

Valid entry is a valid ICAO identifier.

6 GATE

Valid entry is a gate number at the reference airport, POS INIT page.

Oceanic Clearance Request

The OCEANIC CLEARANCE REQUEST page allows request downlinks to obtain clearance via datalink in a more timely manner with reduced risk of incorrect voice transmission. The clearance may be viewed on the MFD or printed.

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z OCEANIC CLEARANCE REQUEST		
1 → FLT NUMBER: □□□□□□ 2 → ENTRY POINT: □□□□□□□□□□	ATC FACILITY: □□□□ ← 4 FLIGHT LEVEL: □□□ ← 5	ETA: □□□□ z ← 6 MACH: □□□ ← 6
FREE TEXT:		
SEND	PRINT	RESET RETURN EXIT

1 FLIGHT NUMBER

Flight number defaults to FMC flight number, if entered. If previously entered and flight number is more than 7 characters, only the first 7 characters display.

When boxes display, valid entry is flight number up to 7 characters.

2 ENTRY POINT

Valid entry is up to 15 characters; tenths of a minute of latitude or longitude may not display. A valid entry must be at least 3 characters. Entries of 7 or more characters are decoded as a latitude/longitude.

3 ETA

If an ENTRY POINT has been entered, it is a waypoint in the active route, and an ETA has not been entered; the ETA box defaults to the predicted ETA at the waypoint.

Valid entry is any time in the range 0000 to 2359.

4 ATC FACILITY

Valid entry is a 4 character ATC facility identifier.

5 FLIGHT LEVEL

Valid entry is a 3 character flight level; for example, 350.

6 MACH

Valid entry is any Mach number between 0.4 and 0.92. Entry of leading zero and decimal point is not required.

ATIS Request

The ATIS REQUEST page allows request downlinks for digital ATIS information without using voice radio. ATIS information may be viewed on the MFD or printed.

ATC

FLIGHT INFORMATION

COMPANY

REVIEW

MANAGER

NEW MESSAGES

1234Z

ATIS REQUEST

1

AIRPORT: □□□□

2

DEPARTURE

ENROUTE

ARRIVAL

3

AUTO

4

TERMINATE

SEND

PRINT

RESET

RETURN

EXIT

1 AIRPORT

If a departure airport exists in the active route and the airplane is on the ground, the default entry is the departure airport. If the destination airport exists in the active route and the airplane is in flight, the default entry is the destination airport. Valid entry is a four character ICAO identifier.

2 ATIS SELECTOR GROUP

The default is none selected. Only one selection can be made at a time. The SEND key becomes active with selection. Pushing the SEND key requests the selected information.

3 AUTOMATIC UPDATE

If ARRIVAL selected, the AUTO update selection box displays. Selection provides automatic updating. If ENROUTE selected, updating is automatic; AUTO does not display.

4 TERMINATE

Displays when an ENROUTE or ARRIVAL AUTO update has been selected. Selection cancels automatic updating and sets ATIS SELECTOR to none selected.

The SEND key becomes active with this selection.

Company Menu

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
COMPANY		
FLIGHT INITIALIZATION	DEPARTURE REPORT	WEATHER REQUESTS
REQUEST AUTO-INITIALIZATION	POSITION REPORT	CREW REQUESTS...
DELAY REPORTS	ARRIVAL REPORT	MAINTENANCE REPORT
DIVERSION	MESSAGE TO GROUND	MISCELLANEOUS CODES
ETA REPORT	VOICE CONTACT REQUEST	SITUATION
FLIGHT TIMES		

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
CREW REQUESTS		
WEIGHT & BALANCE	CLEARANCE	RE-CLEARANCE
FLIGHT PLAN	FLIGHT RELEASE	GATE ASSIGNMENT
ATIS	NOTAMS	

Typical COMPANY Menu

Company downlink menus are accessed by selecting the COMPANY function. Actual menu and page layout is determined by the airline. An example of a typical menu and report page are provided to show common features.

Company Downlink Message Page

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z		
DELAY/DIVERT		
◆ PLANNING TO DIVERT ◆ ACTUAL DIVERT		
DIVERT STATION: KEGG EXPECTED ON TIME: □□□□		
✓ REASON: -----▶ MEDICAL EMERGENCY MEDICAL EMERGENCY WEATHER		
SEND	PRINT	RESET
		RETURN
EXIT		

Typical COMPANY Page

This COMPANY report page shows both exclusive and nonexclusive selections, a required entry, and optional menu selections.

Review Menu

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
REVIEW		
ATC UPLINK...	FLIGHT INFORMATION	SENT...
ATC DOWNLINK...		RECEIVED...
		WEATHER...

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1420Z	REVIEW	
1350Z	ALTITUDE REQUEST	SENT
1315Z	SPEED ALTITUDE ROUTE REQUEST	RESPONSE RCVD
1240Z	WHEN CAN WE EXPECT	RESPONSE RCVD
1234Z	CLIMB TO AND MAINTAIN FL280	ABORTED

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1420Z	VERIFY REQUEST	RESPONSE RCVD
	REQUEST .82, REQUEST CRUISE CLIMB TO FL410 DUE TO WEATHER, REQUEST DIRECT GANDER.	
	FREE TEXT: ROUGH RIDE HERE AT FL350	

Typical REVIEW Menu

Review messages are accessed by selecting the REVIEW menu. Both uplink and downlink messages are displayed in review lists. The review menu is inhibited (cyan) if there are no review messages in that category.

Review State Indicators

Each review message list field and each review message displays the last state of the referenced message. Only one state can apply to a message at a time.

State Indicator	Condition
ABORTED	ATC data link connection lost before sending response to uplink message or completing a downlink message.
ACCEPTING	The received message was displayed and an ACCEPT response was initiated.
ACCEPTED	The received message was displayed, an ACCEPT response was initiated, and the service provider has acknowledged receipt of the response.
DISPLAYED	The received message was displayed (no accept/reject response was required).
NO ACCEPT	The received message was displayed, an ACCEPT response was initiated, but the service provider did not acknowledge receipt of the response.
NO REJECT	The received message was displayed, a REJECT response was initiated, but the message destination did not acknowledge receipt of the response.
NO SEND	The downlink message was initiated to be sent and the service provider did not acknowledge receipt of the message.
REJECTING	The received message was displayed and a REJECT response was initiated.
REJECTED	The received message was displayed, a REJECT response was initiated, and the message destination has acknowledged receipt of the response.
RESPONSE RCVD	ATC uplink message received in response to a downlink request.
SENDING	The downlink message was initiated to be sent.
SENT	The downlink message was initiated to be sent and the service provider has acknowledged receipt of the message.

Manager Functions

Manager Menu

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
MANAGER		
ACARS	SYSTEM INFO	
VHF	PRINTER	
SATCOM	AUTOMATIC MESSAGES	
ADS	MASTER	
HF		

Typical MANAGER Menu

The MANAGER menu page provides access to the manager functions.

ACARS Manager

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z	ACARS	
131.500 2 SEC		
132.750 2 SEC		1
129.450 2 SEC		
135.100 2 SEC		2
SECONDARY FREQUENCY		

The ACARS manager page provides selection of ACARS frequencies, scan rates, and mode. Manager messages related to ACARS are on ACARS page two.

If a FREQUENCY key is selected, the ACARS system tunes to the appropriate frequency and scan rate. If a secondary frequency is entered, the SECONDARY FREQUENCY key becomes active and must be selected to tune to the secondary frequency. Frequency and scan rate selections can be changed automatically by ACARS.

ACARS Manager Page 2/2

[\[Not AIMS 2003\]](#)

ACARS MODE AUTO is the normal ACARS mode. This permits the ACARS system to automatically select the VHF or SATCOM (if VHF is unavailable) mode. If ACARS MODE VHF is selected, ACARS changes to VHF. If ACARS MODE SATCOM is selected, ACARS changes to SATCOM.

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z ACARS ☒ ACARS MODE AUTO ☐ ACARS MODE VHF ☐ ACARS MODE SATCOM (ACARS Manager Messages)		

[\[AIMS 2003 and SATCOM and HF Datalink\]](#)

This page allows the operator to select/deselect VHF, SATCOM, or HF transmission of data. ACARS is set to auto mode (all boxes selected) at power-up or data communication system reset. Normally, this permits ACARS to automatically use VHF, SATCOM (if VHF is unavailable), or HF (if VHF and SATCOM are unavailable). If all boxes are deselected, ACARS loses the capability to send downlink messages, but can receive and display uplink messages.

[\[AIMS 2003 and SATCOM and HF Datalink\]](#)

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z ACARS ☒ VHF ENABLE ☒ SATCOM ENABLE ☒ HF ENABLE (ACARS Manager Messages)		

VHF Manager

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z	VHF	
 DEFAULT RADIO CENTER	 DEFAULT RADIO RIGHT	
 DEFAULT RADIO MODE: DATA	 DEFAULT RADIO MODE: VOICE	
(VHF Manager Messages)		

The VHF manager page provides the capability to select the default radio and to configure the default radio to the voice or data mode. Manager messages related to the VHF system are also presented on this page.

[Not AIMS 2003]

Changes to the default radio selections are inhibited (cyan text) unless ACARS MODE VHF is selected on page 2 of the ACARS manager pages.

If the DEFAULT RADIO CENTER key is selected, the center VHF radio becomes the default radio. If the DEFAULT RADIO RIGHT key is selected, the right VHF radio becomes the default radio.

If the DEFAULT RADIO MODE DATA key is selected, the default radio is set to the data mode. If the DEFAULT RADIO MODE VOICE key is selected, the default radio is set to the voice mode.

Note: The default radio can also be set to the data or voice mode via the Radio Tuning Panel.

HF Manager

[AIMS 2003 and HF Datalink]

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z DEFAULT RADIO LEFT DEFAULT RADIO MODE: DATA HF DEFAULT RADIO RIGHT DEFAULT RADIO MODE: VOICE (HF Manager Messages)		

If the DEFAULT RADIO LEFT is selected, the left HF radio becomes the default radio. If the DEFAULT RADIO RIGHT is selected, the right HF radio becomes the default radio.

If the DEFAULT RADIO MODE: DATA is selected, the default HF radio is set to data mode. If the DEFAULT RADIO MODE: VOICE is selected, the default HF radio is set to voice mode.

Note: The default HF radio can also be set to the data or voice mode via the Radio Tuning Panel.

SATCOM Manager

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z SATCOM (SATCOM Manager Messages)		

The SATCOM manager page displays manager messages related to the SATCOM system.

Automatic Dependent Surveillance Manager

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z ADS		
 ADS ARM	 ADS OFF	
 ADS EMERGENCY	 ADS EMERGENCY OFF	
1225Z ADS CONNECTION NOT ESTABLISHED -OAKXGXA		
1120Z ADS CONNECTION ESTABLISHED -OAKXGXA		
1020Z ADS CONNECTION ESTABLISHED -SEAXGXA		

When ADS is armed, AUTOMATIC position report messages are sent to ATC and COMPANY.

The ADS page controls the following airplane ADS functions:

- ADS ARM – allows airplane ADS functions
- ADS OFF – inhibits airplane ADS functions
- ADS EMERGENCY – sends an alert to ATC indicating an emergency situation (resets to ADS EMERGENCY OFF at power-up)
- ADS EMERGENCY OFF – cancels emergency indication to ATC

A list of ADS connection status is displayed on the ADS page.

System Information Manager

The system information manager page displays manager messages for all applicable systems.

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z SYSTEM INFORMATION		
1 → TAIL NUMBER: N7771	AIRLINE: BO ← 2	
(ALL Manager Messages)		

1 TAIL NUMBER

Normally supplied by the airplane system. When the airplane tail number (registry number) is not available from the system, box prompts are displayed and a value can be entered. A manual entry will remain until power to AIMS is interrupted. Changing this entry after establishing an ATC connection cancels the ATC connection. Tail number is provided on the SELCAL placard.

2 AIRLINE

Normally supplied by the airplane system, but can be manually entered or overwritten. When the airline identifier is not available from the system, box prompts are displayed. A valid entry is two alphanumeric characters and will remain until power to AIMS is interrupted. Changing this value after establishing an ATC connection cancels the ATC connection.

Printer Manager

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z	PRINTER	
	☐ COMPANY MESSAGES FUTURE	

(Display of Printer Manager Messages)

The printer manager page can be set to send messages directly to the printer. Manager messages related to the printer system are also presented on this page. If the COMPANY MESSAGES FUTURE key is selected, company messages are sent directly to the printer and the •PRINTER EICAS message is displayed. Future messages are not included in the new messages or review categories.

Automatic Messages Manager

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z AUTOMATIC MESSAGES		
☒ AUTO MESSAGES OFF ☐ CONFIRM OFF		
(Automatic Messages Manager Messages)		

The AUTO MESSAGES OFF selection inhibits automatic sending of flight operations related messages. Manager messages related to the automatic messages capability are also presented on this page.

When the AUTOMATIC MESSAGES OFF key is selected, the CONFIRM OFF key is displayed. Selecting the CONFIRM OFF key turns off the capability to automatically send flight operations related messages.

Master Manager

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z MASTER		
☒ DATA LINK SYSTEM RESET ☐ CONFIRM RESET		
(Master Manager Messages)		

The master manager page provides the capability to reset the data communication system. Manager messages related to the master features are also presented on this page.

If the DATA LINK SYSTEM RESET key is selected, the CONFIRM RESET key is displayed. If the CONFIRM RESET key is selected, the following occurs:

- ATC connection is reset to not established
- review messages are deleted
- the center VHF radio is selected as the default
- the VHF default radio is set to data mode on the ground or voice mode in the air
- the right HF radio is selected as the default and set to voice mode

- ACARS is set to the auto mode
- automatic messages are set to ON
- the future company messages to printer feature is deselected
- downlink message parameters are initialized
- ADS EMERGENCY is reset to ADS EMERGENCY OFF
- two seconds after selection, the CONFIRM RESET key is removed from the display and the DATA LINK SYSTEM RESET key is displayed as not selected

This reset does not occur at power-up.

[Option – Automatic Reset]

The data communication system is automatically reset after each flight. Reset occurs approximately 10 minutes after the last engine is shut down, and with any entry door open.

Data link capability for the flight management system, OMS, and EICAS related maintenance functions, and cabin functions are not reset with this feature.

Manager Messages

Manager messages are displayed in reverse chronological order (the newest message is nearest the top of the display). The time of occurrence is displayed with each message. The manager messages are listed in the following table.

[AIMS 2003 and HF Datalink]

Function	Manager Message
ACARS	ACARS CONNECTION ESTABLISHED
	NO ACARS CONNECTION
	ACARS MODE VHF - ENABLE
	ACARS MODE VHF - NOT ENABLE
	ACARS MODE SATCOM - ENABLE
	ACARS MODE SATCOM - NOT ENABLE
	ACARS MODE HF - ENABLE
	ACARS MODE HF - NOT ENABLE
ADS	ADS CONNECTION ESTABLISHED – ATC facility
	ADS CONNECTION LOST – ATC facility
	ADS CONNECTIONS LOST

777 Flight Crew Operations Manual

Function	Manager Message
VHF	VHF LINK ESTABLISHED
	NO VHF LINK
	VHF DATA MODE RADIO FAILURE
	VHF DATA MODE RADIO NORMAL
SATCOM	SATCOM LINK ESTABLISHED
	NO SATCOM LINK
	SATCOM DATA MODE FAILED
	SATCOM DATA MODE NORMAL
PRINTER	PRINTER OPERABLE
	PRINTER NOT OPERABLE
	PRINTER BUFFER FULL
	COMPANY FUTURE MESSAGES TO PRINTER – ON
	COMPANY FUTURE MESSAGES TO PRINTER – OFF
AUTOMATIC MESSAGES	AUTOMATIC MESSAGES – ON
	AUTOMATIC MESSAGES – OFF
MASTER	DATA LINK SYSTEM – RESET
HF	HF LINK ESTABLISHED
	NO HF LINK
	HF DATA MODE RADIO FAILURE
	HF DATA MODE RADIO NORMAL

New Messages

New Messages Menu

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1234Z	NEW MESSAGES	
1228Z	CLIMB AND MAINTAIN FL330	ATC
1233Z	PASSENGER INFORMATION – CONNECTING FLIGHTS	
1220Z	WEATHER INFORMATION FOR KPDx, KSFO, KLAX	
1215Z	CONTACT DISPATCH	

Typical NEW MESSAGE List

New uplink messages are displayed with ATC messages displayed above flight information messages which are displayed above company messages. Within ATC, flight information and company, messages are listed by the time they are received. The newest message is at the top of the group. Messages are removed from the list when displayed or an accept/reject response is sent.

New messages can also be accessed by selecting the NEW MESSAGES menu, which displays list boxes for all pending messages. A message is displayed by selecting the appropriate message line.

New ATC uplinks which respond to downlink requests display a key which displays the original downlink request.

New Message – No Response Required

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1233Z		
GATE INFORMATION		
Flight: XX127		
Gate: B1		
ETA: 1245Z		
PRINT		CANCEL

Received messages remain in the new messages list until after they are displayed. If an ACCEPT or REJECT response is required, the message remains in the list until accepted or rejected.

The display above shows a received message that does not require a response. The ACCEPT and REJECT keys are not displayed for this message. The message can be cleared by selecting the CANCEL key on the MFD or pushing the CANCEL switch on the glareshield.

New Message – Response Required

ATC	FLIGHT INFORMATION	COMPANY
REVIEW	MANAGER	NEW MESSAGES
1233Z	GATE INFORMATION	
Flight: XX127 Gate: B1 ETA: 1245Z		
ACCEPT	PRINT	APPEND REJECT

The display above shows a message that requires an ACCEPT or REJECT response. The ACCEPT and REJECT keys are displayed.

An APPEND capability is provided for certain received messages which require an accept or reject response. In this case, the APPEND key is displayed.

Intentionally
Blank

Communications**EICAS Messages****Chapter 5****Section 50****Communications EICAS Alert Messages**

The following EICAS alert messages can be displayed.

Message	Level	Aural	Message Logic
DATALINK LOST	Advisory		Datalink is temporarily lost.
DATALINK SYS	Advisory		Datalink system has failed.

[\[AIMS 2003 and HF Datalink\]](#)

HF DATALINK	Advisory		HF datalink has failed.
-------------	----------	--	-------------------------

RADIO TRANSMIT	Advisory		A VHF or HF radio is keyed for 30 seconds or more.
SATCOM	Advisory		SATCOM system has failed.
SATCOM DATALINK	Advisory		SATCOM datalink has failed.
SATCOM VOICE	Advisory		SATCOM voice communication has failed.
SATVOICE LOST	Advisory		SATCOM voice communication is temporarily lost.
VHF DATALINK	Advisory		VHF datalink has failed.

EICAS Communication Messages

The following EICAS communication messages can be displayed.

Message	Level	Message Logic	Crew Action
•ATC	Medium	An ATC data link message has been received or an armed report has been sent.	Respond to message displayed on EICAS or select the MFD communications display.

[Passenger]

•CABIN ALERT	Medium	Pilot alert received over cabin interphone.	Respond to the alert.
--------------	--------	---	-----------------------

[Passenger]

•CABIN CALL	Medium	Pilot call received over cabin interphone.	Respond to the call.
-------------	--------	--	----------------------

[Passenger]

•CABIN READY	Medium	CABIN READY received over cabin interphone.	Crew awareness. Automatically removed after one minute.
--------------	--------	---	---

[Freighter]

•CARGO CALL	Medium	Pilot call received over cabin interphone from loadmaster amplifier panel or wing inspection station.	Respond to the call.
-------------	--------	---	----------------------

•COMM	Medium/low	A data link message has been received.	Select COMM display on the MFD.
•COMM BUSY	Medium	Communications system pending data link message queue is full.	Respond to current pending data link messages.

777 Flight Crew Operations Manual

Message	Level	Message Logic	Crew Action
---------	-------	---------------	-------------

[Freighter]

•CREW REST CALL	Medium	Pilot call received over cabin interphone from crew rest.	Respond to the call.
-----------------	--------	---	----------------------

•FMC	Medium	An FMC related data link message has been received.	Select FMC from the CDU MENU page if not already in the FMC mode. View the message title in the CDU scratchpad. View the message on the appropriate CDU page.
•GROUND CALL	Medium	Pilot call received over flight interphone from nose wheel well.	Respond to the call.
•PRINTER (with data link installed)	Medium/low	A data link message has been received and sent to the printer.	Review the printed message.
•SATCOM MESSAGE	Medium/low	SATCOM voice system information available if SATCOM system is selected on a CDU.	View the SATCOM CDU message.
•SELCAL	Medium	SELCAL received or any SATCOM voice call received.	Respond to the call.

[Freighter]

•SUPRNMRY CALL	Medium	Pilot call received over cabin interphone from supernumerary seating area.	Respond to the call.
----------------	--------	--	----------------------

Intentionally
Blank

Electrical**Chapter 6****Table of Contents****Section 0**

Controls and Indicators	6.10
Electrical Panel	6.10.1
Overhead Maintenance Panel	6.10.8
Standby Power Switch	6.10.8
Towing Power Switch	6.10.9
Medical Outlet Power Control	6.10.10
Electrical Synoptic Display	6.10.11
System Description	6.20
Introduction	6.20.1
AC Electrical System	6.20.1
Electrical Load Management System (ELMS)	6.20.1
AC Electrical System Power Sources	6.20.1
AC Electrical Power Distribution	6.20.4
AC Electrical System Schematic	6.20.7
Backup AC Electrical System	6.20.8
Backup Generators	6.20.8
Backup AC Electrical System Schematic	6.20.9
DC Electrical System	6.20.10
Main DC Electrical System	6.20.10
Batteries	6.20.10
Towing Power	6.20.11
DC and Flight Control Electrical Systems Schematic	6.20.12
Flight Control DC Electrical System	6.20.13
Standby Electrical System	6.20.13
Standby Electrical System Schematic	6.20.14
Main Battery	6.20.14
Standby Inverter	6.20.15
Ram Air Turbine (RAT) Generator	6.20.15
Cabin Systems and Utility Power	6.20.15
IFE and Passenger Seats	6.20.15

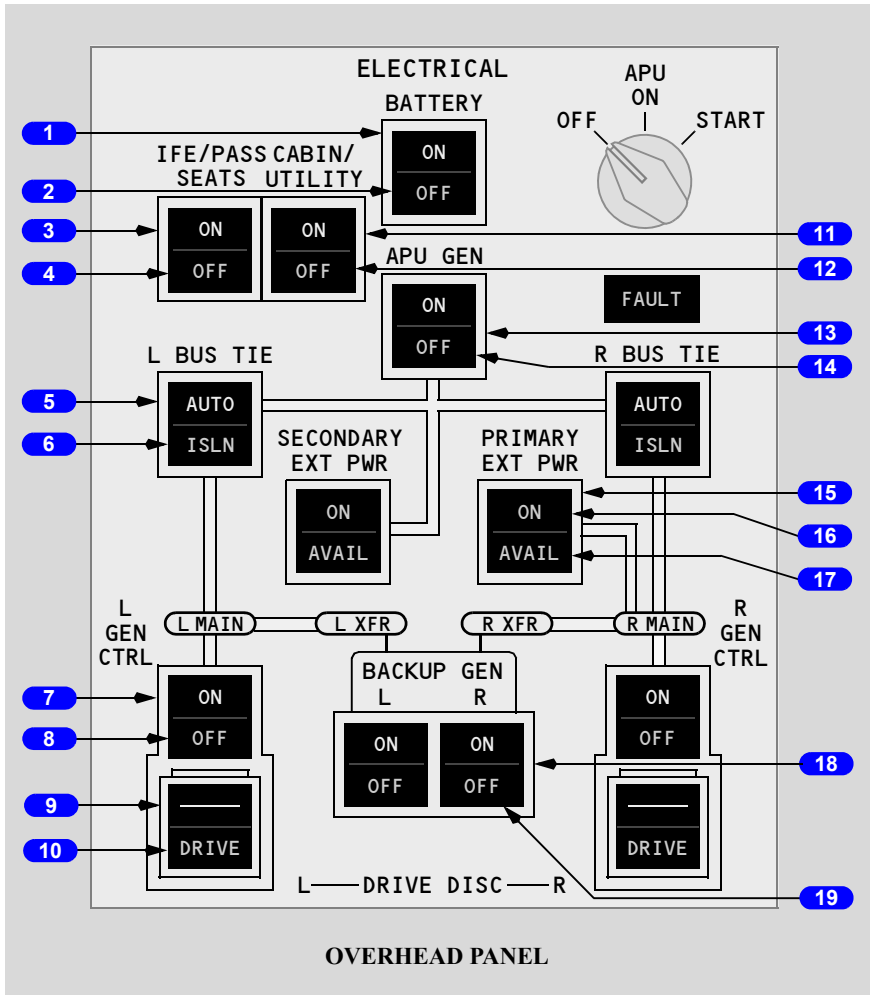
Cabin and Utility Systems.	6.20.15
Cabin and Utility Systems.	6.20.16
Flight Deck Video System Power	6.20.17
Flight Deck Video Camera System Power.	6.20.17
EICAS Messages	6.30
Electrical EICAS Alert Messages	6.30.1

Electrical Controls and Indicators

Chapter 6 Section 10

Electrical Panel

[IFE/PASS SEATS and CABIN/UTILITY switches basic with C/L 350]
[Passenger]



1 BATTERY Switch

ON –

- unpowered airplane on the ground:
 - some switch annunciator lights are illuminated
 - allows the APU to be started
- on the ground after AC power is removed or lost:
 - standby busses and emergency lighting are powered
 - the left inboard, outboard, and upper center displays, and the left CDU are powered.

OFF –

- on the ground, battery power is removed and the EICAS advisory message ELEC BATTERY OFF is displayed
- in flight, the EICAS advisory message ELEC BATTERY OFF is displayed.

2 Battery OFF Light

Illuminated (amber) – the battery switch is OFF.

3 In-Flight Entertainment System/Passenger Seats (IFE/PASS SEATS) Power Switch

ON – powers IFE, passenger seat, ground maneuver camera, and flight deck entry video surveillance systems when AC power is available.

ON – powers IFE, passenger seat, and flight deck entry video surveillance systems when AC power is available.

OFF – removes power from IFE, passenger seat, ground maneuver camera, and flight deck entry video surveillance systems.

OFF – removes power from IFE, passenger seat, and flight deck entry video surveillance systems.

4 IFE/PASS SEATS OFF Light

Illuminated (amber) – the IFE/PASS SEATS Power switch is OFF.

5 BUS TIE Switches

AUTO – arms automatic AC bus tie circuits.

ISLN (isolation) (AUTO not visible) – commands the bus tie open.

6 Bus Isolation (ISLN) Lights

Illuminated (amber) –

- bus tie breaker is locked open (ISLN selected with bus tie switch), or
- a fault has occurred, automatically opening the bus tie breaker.

7 Generator Control (GEN CTRL) Switches

ON – arms the generator breaker to close automatically when generator power is available.

OFF –

- opens field and generator breakers
- resets fault trip circuitry.

8 Generator OFF Lights

Illuminated (amber) – the generator breaker is open.

9 Drive Disconnect Switches

Push –

- disconnects the integrated drive generator (IDG) input from the engine
- requires maintenance action on the ground to reconnect the IDG.

10 Generator DRIVE Lights

Illuminated (amber) – IDG oil pressure is low.

11 Cabin/Utility (CABIN/UTILITY) Power Switch

ON – powers cabin and utility systems when AC power is available.

OFF – removes power from cabin and utility systems and turns on some cabin lighting.

12 CABIN/UTILITY Power OFF Light

Illuminated (amber) – CABIN/UTILITY power switch is selected OFF.

13 APU Generator (APU GEN) Switch

ON – arms APU generator breaker to automatically close.

OFF – opens APU generator breaker.

14 APU Generator OFF Light

Illuminated (with the APU running) (amber) –

- the APU generator breaker is open because of a fault, or
- the APU GENERATOR switch is selected OFF.

15 External Power (EXT PWR) Switches

Push – if AVAIL light is illuminated, closes external power contactor. Subsequent action opens external power contactor.

ON – external power is connected to the bus(es).

OFF (ON not visible) – external power is disconnected from the bus(es).

16 External Power ON Lights

Illuminated (green) – external power is powering the busses.

17 External Power AVAIL Lights

Illuminated (green) –

- external power is plugged in and power quality is acceptable
- extinguishes when the ON light illuminates.

18 Backup Generator (BACKUP GEN) Switches

ON – backup generator operation is armed.

OFF –

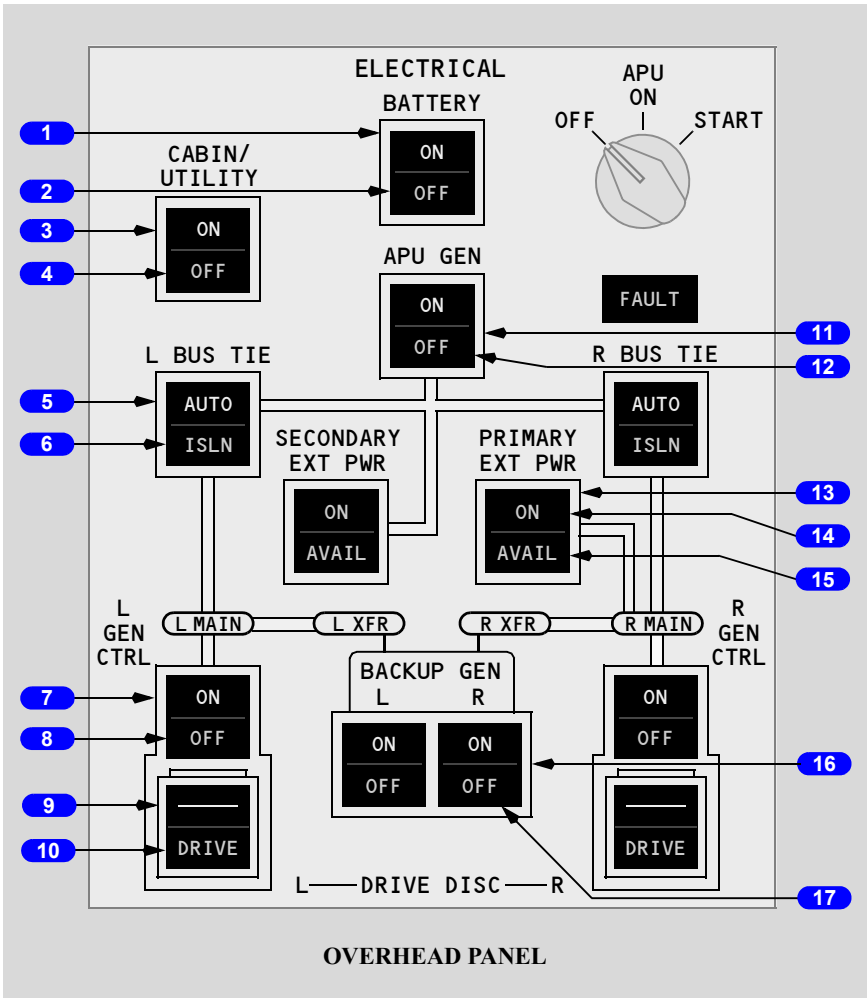
- opens the backup generator control relay
- resets the fault circuitry.

19 Backup Generator OFF Lights

Illuminated (amber) –

- the backup generator has failed, or
- a circuit fault has been detected, or
- backup generator switch selected off, or
- both OFF lights illuminated – backup system (converter) has failed.

[Freighter]

**1 BATTERY Switch**

ON –

- unpowered airplane on the ground:
 - some switch annunciator lights are illuminated
 - allows the APU to be started
- on the ground after AC power is removed or lost:
 - standby busses and emergency lighting are powered
 - the left inboard, outboard, and upper center displays, and the left CDU are powered.

OFF –

- on the ground, battery power is removed and the EICAS advisory message ELEC BATTERY OFF is displayed
- in flight, the EICAS advisory message ELEC BATTERY OFF is displayed.

2 Battery OFF Light

Illuminated (amber) – the battery switch is OFF.

3 Cabin/Utility (CABIN/UTILITY) Power Switch

ON – powers cabin and utility systems when AC power is available.

OFF – removes power from cabin and utility systems and turns on some cabin lighting.

4 CABIN/UTILITY Power OFF Light.

Illuminated (amber) – CABIN/UTILITY power switch is selected OFF.

5 BUS TIE Switches

AUTO – arms automatic AC bus tie circuits.

ISLN (isolation) (AUTO not visible) – commands the bus tie open.

6 Bus Isolation (ISLN) Lights

Illuminated (amber) –

- bus tie breaker is locked open (ISLN selected with bus tie switch), or
- a fault has occurred, automatically opening the bus tie breaker.

7 Generator Control (GEN CTRL) Switches

ON – arms the generator breaker to close automatically when generator power is available.

OFF –

- opens field and generator breakers
- resets fault trip circuitry.

8 Generator OFF Lights

Illuminated (amber) – the generator breaker is open.

9 Drive Disconnect Switches

Push –

- disconnects the integrated drive generator (IDG) input from the engine
- requires maintenance action on the ground to reconnect the IDG.

10 Generator DRIVE Lights

Illuminated (amber) – IDG oil pressure is low.

11 APU Generator (APU GEN) Switch

ON – arms APU generator breaker to automatically close.

OFF – opens APU generator breaker.

12 APU Generator OFF Light

Illuminated (with the APU running) (amber) –

- the APU generator breaker is open because of a fault, or
- the APU GENERATOR switch is selected OFF.

13 External Power (EXT PWR) Switches

Push – if AVAIL light is illuminated, closes external power contactor. Subsequent action opens external power contactor.

ON – external power is connected to the bus(es).

OFF (ON not visible) – external power is disconnected from the bus(es).

14 External Power ON Lights

Illuminated (green) – external power is powering the busses.

15 External Power AVAIL Lights

Illuminated (green) –

- external power is plugged in and power quality is acceptable
- extinguishes when the ON light illuminates.

16 Backup Generator (BACKUP GEN) Switches

ON – backup generator operation is armed.

OFF –

- opens the backup generator control relay
- resets the fault circuitry.

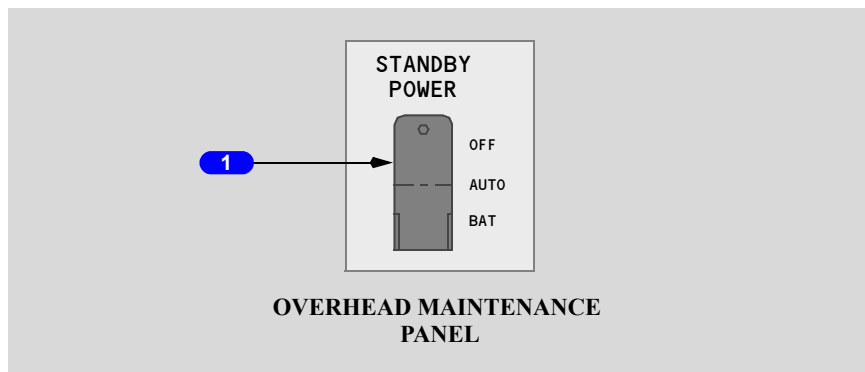
17 Backup Generator OFF Lights

Illuminated (amber) –

- the backup generator has failed, or
- a circuit fault has been detected, or
- backup generator switch selected off, or
- both OFF lights illuminated – backup system (converter) has failed.

Overhead Maintenance Panel

Standby Power Switch



1 STANDBY POWER Switch

Note: Ground operation only.

OFF – the AC standby bus is not powered.

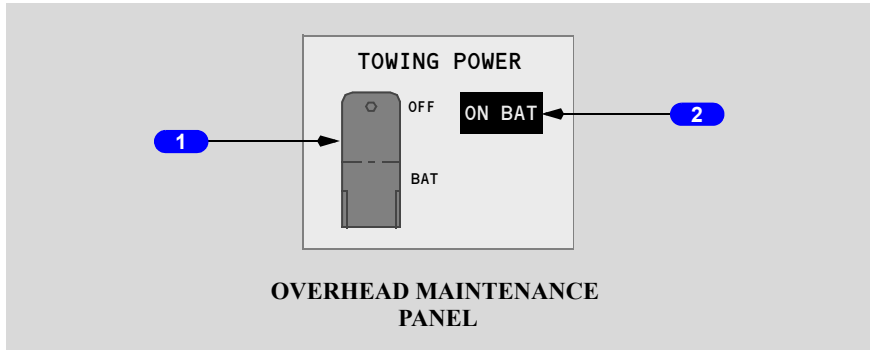
AUTO (guarded) – the standby busses transfer to battery power if normal AC power is lost.

BAT (momentary) –

- the standby busses are powered from the battery if AC power is not available
- initiates a DC/standby self-test if AC power is available.

Towing Power Switch

[Option]



1 TOWING POWER Switch (Ground Operation Only)

OFF – main battery disconnected from towing bus.

BAT – main battery power provided to the following:

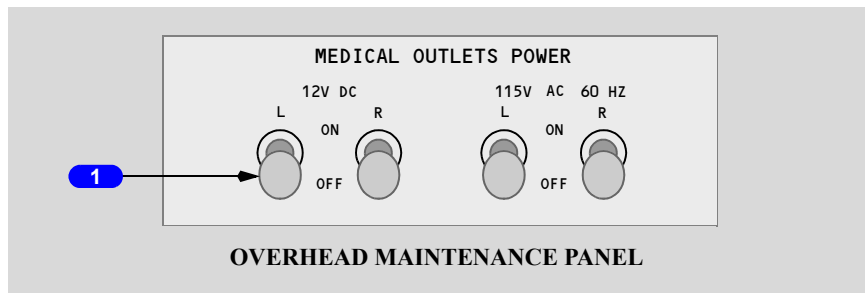
- position lights
- flight interphone
- Captain's instrument panel flood lights
- brake accumulator pressure indicator
- brake source light

2 Towing Power ON BAT Light

Illuminated (white) – towing bus powered by main battery through the hot battery bus.

Medical Outlet Power Control

[Option - other switch configurations are available]



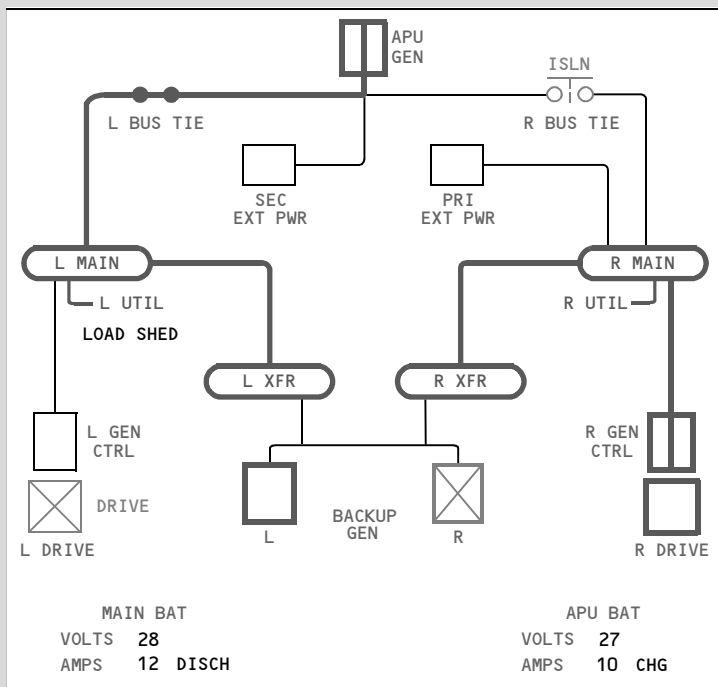
1 MEDICAL OUTLETS POWER Switches

ON – Power is available to all associated passenger cabin medical outlets.

OFF – Medical outlet power is not available.

Electrical Synoptic Display

The electrical synoptic is displayed by pushing the ELEC synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.



MULTIFUNCTION DISPLAY

CHG ... BATTERY CHARGING

CTRL .. CONTROL

DISCH . BATTERY DISCHARGING

DRIVE . OIL PRESSURE LOW
(AMBER)ISLN .. BUS TIE OPEN DUE TO
ELECTRICAL FAULT OR
BUS TIE SWITCH OFF
(AMBER)
 DRIVE DISCONNECTED
ENGINE RUNNING
(AMBER)

 ON OR AVAILABLE
(GREEN)

 OFF
(WHITE)

 NOT SUPPLYING POWER
OR FAILED
(AMBER)

 POWER FLOWING
(GREEN)

 POWER NOT FLOWING
(WHITE)

Intentionally
Blank

**Electrical
System Description****Chapter 6
Section 20****Introduction**

The electrical system generates and distributes AC and DC power to other airplane systems, and is comprised of: main AC power, backup power, DC power, standby power, and flight controls power. System operation is automatic. Electrical faults are automatically detected and isolated.

AC Electrical System

The AC electrical system is the main source for airplane electrical power.

Electrical Load Management System (ELMS)

The ELMS provides load management and protection to ensure power is available to critical and essential equipment.

If the electrical loads exceed the power available (airplane or external), ELMS automatically sheds AC loads by priority until the loads are within the capacity of the airplane or ground power generators. The load shedding is galleys first, then utility busses. Utility busses are followed by individual equipment items powered by the main AC busses. When an additional power source becomes available or the loads decrease, ELMS restores power to shed systems (in the reverse order). The message LOAD SHED displays on the electrical synoptic when load shed conditions exist.

The ELMS also provides inputs for display of EICAS messages for manual center tank fuel pump shut off during climb/cruise, and automatic shut off to prevent unintentional dry fuel pump operation when the center fuel tank is empty.

AC Electrical System Power Sources

The entire airplane AC electrical load can be supplied by any two main AC power sources.

The main AC electrical power sources are:

- left and right engine integrated drive generators (IDGs)
- APU generator
- primary and secondary external power.

The power sources normally operate isolated from one another. During power source transfers on the ground (such as switching from the APU generator to an engine generator) operating sources are momentarily paralleled to prevent power interruption.

Integrated Drive Generators (IDGs)

Each engine has an IDG. Each IDG has automatic control and system protection functions.

When an engine starts, with the GENERATOR CONTROL switch selected ON, the IDG automatically powers the respective main bus. The previous power source is disconnected from that bus.

The IDG can be electrically disconnected from the busses by pushing the GENERATOR CONTROL switch to OFF. The IDG can also be electrically disconnected from its respective bus by selecting an available external power source prior to engine shutdown. (See Primary External Power and Secondary External Power in this section.)

The DRIVE light illuminates and the EICAS message ELEC GEN DRIVE L or R displays when low oil pressure is detected in an IDG. The IDG drive can be disconnected from the engine by pushing the respective DRIVE DISCONNECT switch. The IDG cannot be reconnected by the flight crew.

High drive temperature causes the IDG to disconnect automatically.

APU Generator

The APU generator is electrically identical to the IDG generators. The APU generator can power either or both main busses, and may be used in flight as a replacement to an IDG source.

If no other power source is available when the APU generator becomes available, the APU generator automatically connects to both main AC busses. If the primary external source is powering both main busses, the APU powers the left main bus, and the primary external source continues to power the right main bus. If the primary external source is powering the right main bus, and the secondary external source is powering the left main bus, the APU then powers the left main bus and the primary external source continues to power the right main bus. If the secondary external source is powering both main busses, the APU then powers both main busses.

The APU generator OFF light illuminates when the APU is operating and the APU generator breaker is open because of a fault or the APU GENERATOR switch is selected OFF. When the APU GENERATOR switch is ON and a fault is detected, the APU generator cannot connect to the busses.

In flight, when both transfer busses are unpowered, the APU starts automatically, regardless of APU selector position. Refer to Chapter 7, Engines, APU for APU starter operation.

Primary External Power

Primary external power can power the left and right main busses. When the primary power source voltage and frequency are within limits, the primary external power AVAIL (available) light illuminates. If no AC power is applied, either external power source will power the airplane if the BATTERY switch is ON.

If no other source is powering the main busses, with the BATTERY switch ON, pushing the PRIMARY EXTERNAL POWER switch ON connects primary external power to both main busses. When primary external power is connected to a main bus, the PRIMARY EXTERNAL POWER ON light illuminates and the AVAIL light extinguishes.

If a single IDG powers both busses, pushing the PRIMARY EXTERNAL POWER switch ON connects primary external power to both busses and removes the IDG source.

If both IDGs are powering their respective busses, the APU generator is NOT running and secondary external power is NOT available, pushing the PRIMARY EXTERNAL POWER switch ON connects primary external power to both busses and removes the IDG sources.

If both IDGs are powering their respective busses, and secondary external power is available, pushing the PRIMARY EXTERNAL POWER switch to ON connects primary external power to the right main bus, leaving the left main bus powered from the left IDG.

If the APU generator is running, pushing the PRIMARY EXTERNAL POWER switch ON connects primary external power to the right main bus, leaving the previous source connected to the left main bus.

If both busses are powered from secondary external power, pushing the PRIMARY EXTERNAL POWER switch ON connects primary external power to the right main bus, leaving secondary external power connected to the left main bus.

Pushing the PRIMARY EXTERNAL POWER switch while primary external power is ON, disconnects primary external power. The previously connected power source is reconnected, if available.

Secondary External Power

Secondary external power can power the left and right main busses. When the secondary external power source voltage and frequency are within limits, the secondary external power AVAIL (available) light illuminates.

If no AC power is applied, the BATTERY switch must be ON or primary external power must be available for secondary external power to power the airplane. If the BATTERY switch is ON and no other source is powering the main busses, pushing the SECONDARY EXTERNAL POWER switch ON connects secondary external power to both main busses. When secondary external power is connected to a main bus, the SECONDARY EXTERNAL POWER ON light illuminates and the AVAIL light extinguishes.

If a single IDG powers both main busses, pushing the SECONDARY EXTERNAL POWER switch ON connects secondary external power to both busses and removes the IDG source. Similarly, if only secondary external power is available and both IDGs are powering their respective busses, pushing the SECONDARY EXTERNAL switch ON connects secondary external power to the left main bus. When the right engine is shut down, there is a no-break transfer of power of secondary external power to the right main bus.

If both IDGs are powering their respective busses, and both secondary and primary external power are available, pushing the SECONDARY EXTERNAL POWER switch ON connects secondary external power to the left main bus, leaving the right main bus powered from the right IDG.

If the APU generator is running, pushing the SECONDARY EXTERNAL POWER switch ON connects secondary external power to the left main bus, leaving the right IDG or primary external power connected to the right main bus.

If both busses are powered from primary external power, pushing the SECONDARY EXTERNAL POWER switch ON connects secondary external power to the left main bus, leaving primary external power connected to the right main bus. If no other source is available, secondary external power is connected to both main busses.

Pushing the SECONDARY EXTERNAL POWER switch while secondary external power is ON disconnects secondary external power. The previously connected power source is reconnected, if available.

AC Electrical Power Distribution

AC power is distributed through the left and right main busses and the ground service bus.

AC Main Busses

The right IDG normally powers the right main bus and the left IDG normally powers the left main bus. The APU normally powers both main busses when they are not powered by any other source.

When external power is connected:

- primary external power normally powers the right main bus
- secondary external power normally powers the left main bus.

Bus tie relays, controlled by BUS TIE switches, isolate or parallel the right and left main busses. When both BUS TIE switches are set to AUTO, the bus tie system operates automatically to maintain power to both main busses.

Power transfers are made without interruption when the airplane is on the ground, except when switching between primary and secondary external power sources.

The source order for powering left and right main busses in flight is the:

- respective IDG
- APU generator
- opposite IDG.

The main busses power individual equipment items such as:

- cooling vent fan
- recirculation fans
- lavatory/galley fans
- electric hydraulic pumps
- IFE

Each main bus also powers its associated busses (typical loads are shown in parentheses):

- transfer bus (DC system transformer–rectifiers, AC standby bus)
- utility bus (forward galley heater, chiller boost fan, gasper fan, captain's and first officer's foot and shoulder heaters, door area heaters, lavatory water heaters and shavers)
- galley busses.

Ground Service Bus

The ground service bus is normally powered by the right main bus. Alternate sources of power for the ground service bus are:

- the APU generator
- primary external power.

The ground service bus powers:

- the main battery charger
- the APU battery charger
- miscellaneous cabin and system loads.

Ground Handling Bus

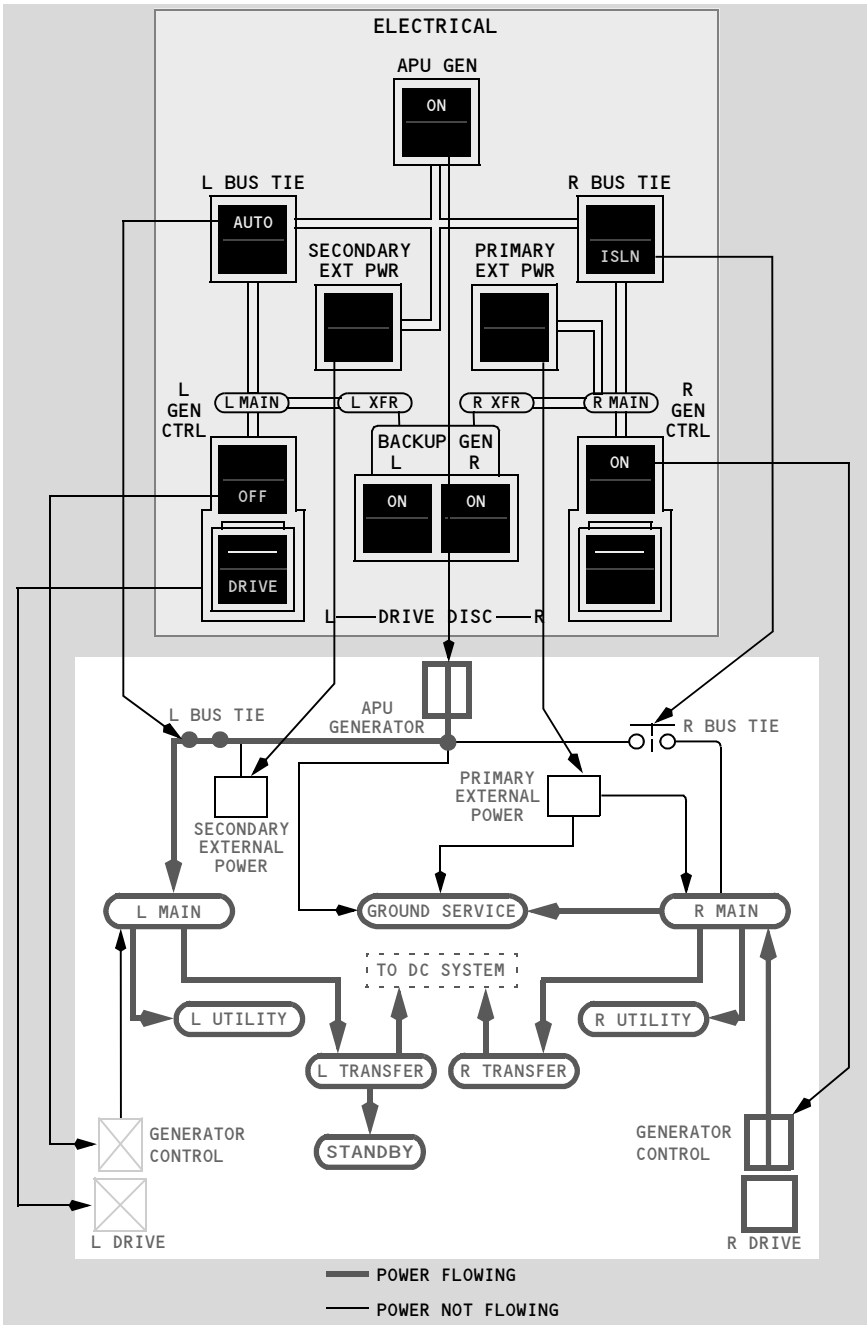
The ground handling bus can be powered on the ground only from the APU generator or from the primary external power source. It is provided for loads such as cargo handling, fueling/defueling operations, and other equipment energized only during ground operations.

Autoland

During autoland, the busses isolate to allow three independent sources to power the three autopilots:

- the left IDG powers the left AC transfer bus, the left main DC bus, and the captain's flight instrument bus
- the right IDG powers the battery bus and AC standby bus through the main battery charger
- the backup system powers the right AC transfer bus, the right DC bus, and the first officer's flight instrument bus.

AC Electrical System Schematic



Backup AC Electrical System

The backup electrical system is designed to automatically provide power to selected airplane systems. The backup electrical system automatically powers one or both transfer busses when:

- only one main AC generator (includes APU) is available
- power to one or both of the main AC busses is lost
- approach (APP) mode is selected for autoland
- the system is automatically tested after engine starts.

The system transfers power without interruption.

Backup Generators

Backup power is provided by one variable speed, variable frequency generator mounted on each engine. A frequency converter converts the generator frequency to a constant 400 Hz. Only one backup generator can power the converter at a time.

Each backup generator contains two permanent magnet generators (PMGs) that supply power to the flight control DC electrical system (refer to DC Electrical System).

If both IDGs and the APU generator are inoperative, a backup generator powers essential airplane equipment. To reduce electrical loading on the backup generator, the following systems are inoperative:

- TCAS
- SATCOM
- Right HF radio

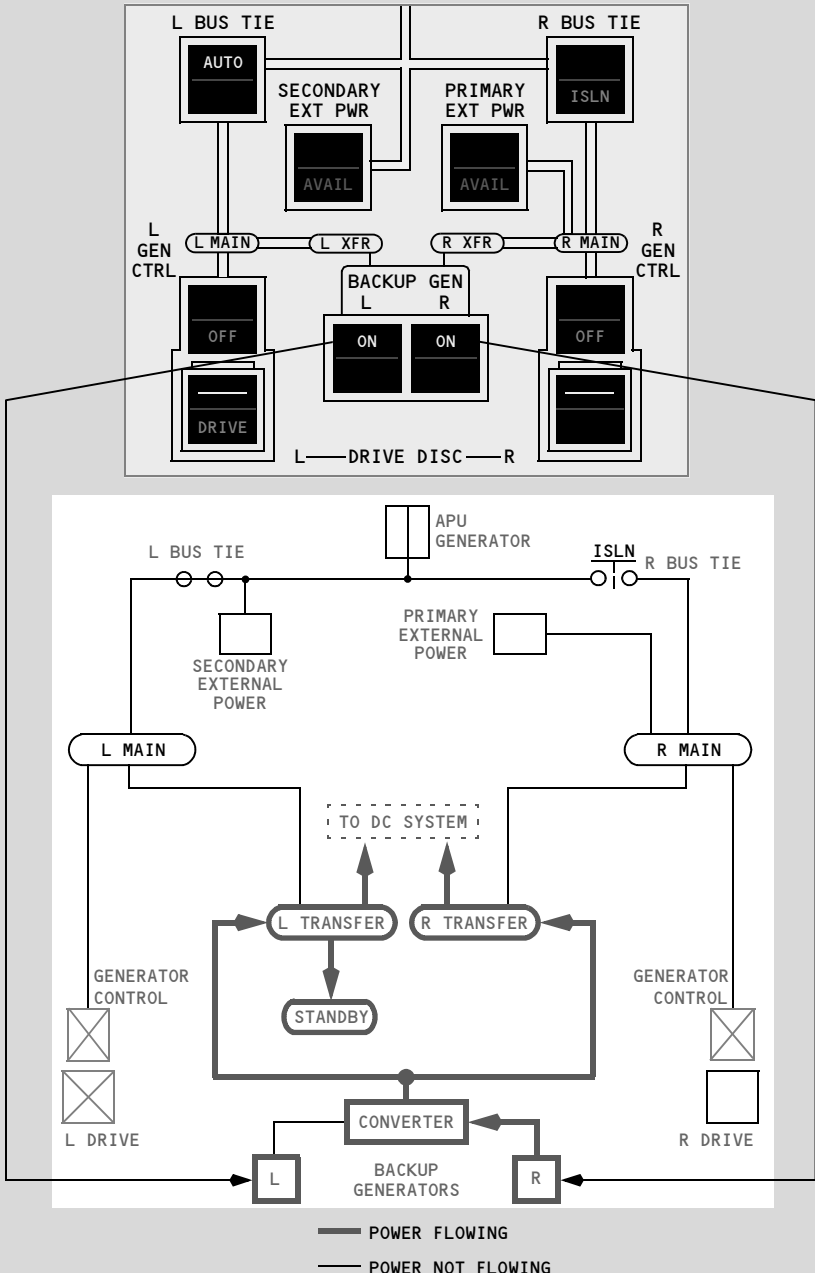
[HF Datalink installed]

- Right HF radio and associated datalink
- Center tank override/jettison pumps (center tank fuel is unusable and cannot be jettisoned)

[777-200LR]

- Center tank override/jettison pumps (center tank and auxiliary fuel is unusable and cannot be jettisoned)
- Position and other exterior lights (except nose gear landing lights)
- All non-essential cabin equipment (galleys, entertainment systems, etc.)
- Passenger cabin lighting (except night, galley and cross-aisle lights)
- Supernumerary cabin lighting (except night, galley and cross-aisle lights)
- Cabin temperature control (remains operative, but in degraded mode)

Backup AC Electrical System Schematic



DC Electrical System

The DC electrical system includes the main DC electrical system and the flight control DC electrical system.

Main DC Electrical System

The main DC electrical system uses four transformer–rectifier units (TRUs) to produce DC power. The TRUs are powered by the AC transfer busses.

Main DC Power Distribution

TRU DC electrical power is distributed to various DC busses as follows:

The left TRU powers the left main DC bus, which provides a second DC power source for:

- left flight control power supply assembly (PSA)
- right main DC bus.

The right TRU powers the right main DC bus, which provides a second DC power source for:

- right flight control PSA
- left main DC bus.

The C1 TRU powers the captain's flight instrument bus and the battery bus. The captain's flight instrument bus provides a second DC power source for:

- center flight control PSA
- first officer's flight instrument bus

The C2 TRU powers the first officer's flight instrument bus, which provides a second DC power source for the captain's instrument bus.

Batteries

The main battery is connected directly to the hot battery bus and provides standby power to other busses (See Standby Electrical System). The main battery charger normally powers the hot battery bus and maintains the main battery fully charged.

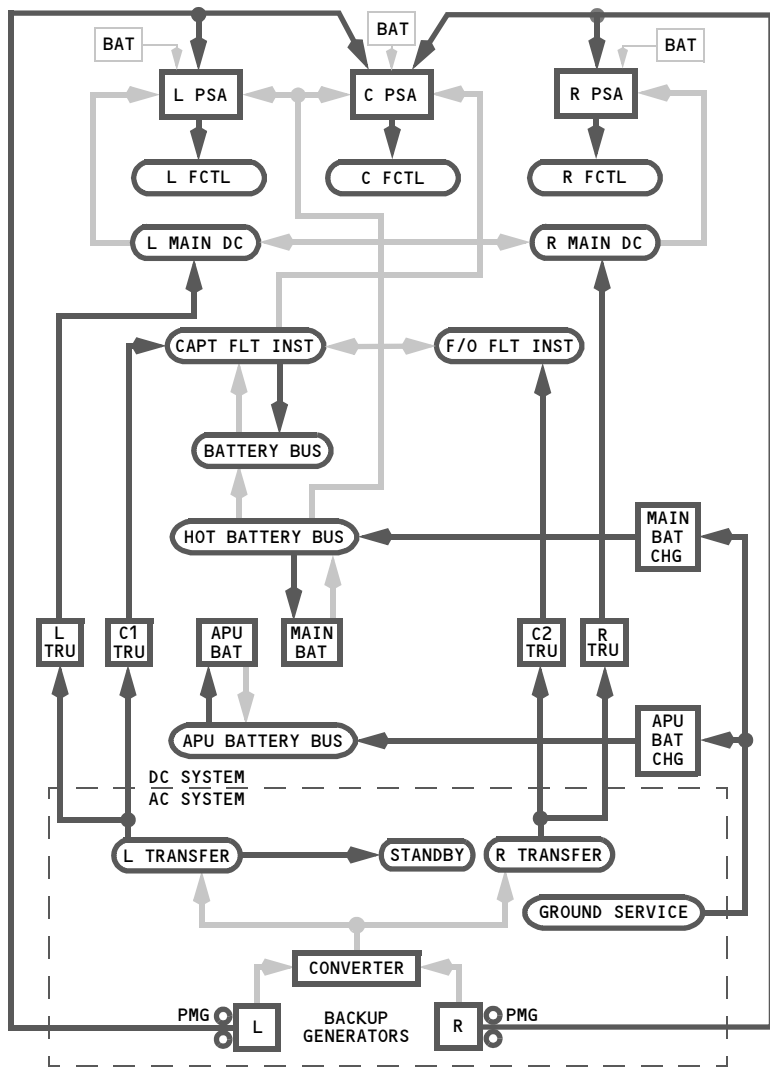
The APU battery is connected directly to the APU battery bus and provides dedicated power to the APU electric starter, which is used when sufficient bleed air duct pressure is unavailable for the APU air turbine starter. The APU battery charger normally powers the APU battery bus and maintains the APU battery fully charged.

Towing Power

[Option]

Permits towing operations without AC power. With the TOWING POWER switch selected to BAT position, main battery power is provided through the hot battery bus to systems required for towing. When AC power is applied to the airplane and the TOWING POWER switch is in BAT, the main battery provides back-up if AC power is lost during towing.

DC and Flight Control Electrical Systems Schematic



— PRIMARY POWER	FCTL -- FLIGHT CONTROL DC BUS
- - - ALTERNATE/STANDBY/BACKUP POWER	FLT INST -- FLIGHT INSTRUMENT BUS
	BAT CHG -- BATTERY CHARGER
	PSA -- POWER SUPPLY ASSEMBLY

Flight Control DC Electrical System

The flight control DC electrical system is a dedicated power source for the primary flight control system.

Primary power for the flight control DC electrical system comes from permanent magnet generators (PMGs) housed within each backup generator. Variable frequency PMG AC power is used by individual power supply assemblies (PSAs) to provide DC power to the three flight control DC busses.

To ensure a high level of system reliability, each PSA also has multiple DC power sources. If primary PMG AC power is not available, secondary power for the left and right PSAs is provided by the related main DC bus. Secondary power for the center PSA is provided by the captain's flight instrument bus. The hot battery bus provides additional backup power for the left and center PSAs only.

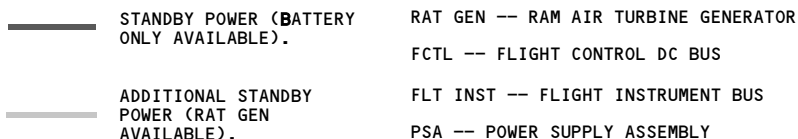
Each PSA also uses a dedicated battery to prevent power interruptions to the related flight control DC bus. The batteries have limited capacity and are incorporated to supply power for brief periods during PSA power source transfers.

Standby Electrical System

The standby electrical system can supply AC and DC power to selected flight instruments, communications and navigation systems, and the flight control system, if there are primary electrical power system failures.

The standby electrical system consists of:

- the main battery
- the standby inverter
- the RAT generator and its associated generator control unit
- the C1 and C2 TRUs.



- hot battery bus
- battery bus
- captain's flight instrument bus
- left and center flight control PSAs
- standby inverter.

Standby Inverter

The standby inverter converts DC power to AC power. The inverter powers the AC standby bus if the left transfer bus is not powered.

Ram Air Turbine (RAT) Generator

The RAT generator provides standby power to the C1 and C2 TRUs. The RAT generator has no operating time limits, and operates at all airspeeds and altitudes.

The RAT can supply electrical and hydraulic power simultaneously. If the RAT is unable to maintain RPM, the RAT generator electrical load is shed until RPM is satisfactory. Power for standby electrical loads is provided by the main battery during deployment of the RAT and when RAT generator loads are shed.

The RAT is deployed automatically if both AC transfer busses lose power in flight. The RAT can be manually deployed by pushing the RAM AIR TURBINE switch on the overhead panel.

RAT deployment and operation are described in Chapter 13, Hydraulics.

Cabin Systems and Utility Power

[IFE/PASS SEATS and CABIN/UTILITY switches basic with C/L 350]

Electrical power to some cabin and utility systems are controlled from the flight deck.

IFE and Passenger Seats

The IFE/PASS SEATS Power switch controls power to the IFE and passenger seats. Pushing the switch OFF removes power from:

- all IFE components
- passenger seats, including:
 - seat motor power
 - personal computer power outlets, and
 - telephones

Cabin and Utility Systems

The CABIN/UTILITY Power switch controls power to cabin and utility systems. When the switch is OFF power is removed from:

- ground service bus, except:
 - main and APU battery chargers
 - left forward fuel pump
- utility busses
- galleys

[Option]

- gasper fan
- fluorescent cabin lighting
- beacon, logo, and wing lights

Additionally, when the CABIN/UTILITY Power switch is OFF, power is provided to:

- night and supplemental night lights
- reading lights
- attendant work lights
- some galley and crew rest lights.

Cabin and Utility Systems

The CABIN/UTILITY Power switch controls power to cabin and utility systems. When the switch is OFF power is removed from:

- ground service bus, except:
 - main and APU battery chargers
 - left forward fuel pump
- utility busses
- galley
- gasper fan
- beacon, logo, and wing lights
- main deck cargo, lower forward cargo, lower aft cargo compartment electrical power outlets
- supernumerary general lights
- main deck alert system, and
- in flight, main deck cargo lights.

Additionally, when the CABIN/UTILITY Power switch is OFF, power is provided to:

- night and supplemental night lights
- reading lights
- some galley and crew rest lights.

Power is removed from the main deck cargo, lower forward cargo, lower aft cargo compartment electrical power outlets when the respective compartment CARGO FIRE ARM switch is in ARMED.

Flight Deck Video System Power

[\[-300 series airplanes with Flight Deck Entry Video Surveillance System\]](#)

The IFE/PASS SEATS Power switch controls power to the flight deck video system. Pushing the switch OFF removes power from the following:

- Ground maneuver camera system
- Flight deck entry video surveillance system.

Flight Deck Video Camera System Power

[\[-200 series airplanes with Flight Deck Entry Video Surveillance System\]](#)

The IFE/PASS SEATS Power switch controls power to the flight deck entry video surveillance system. Pushing the switch OFF removes power from the system.

Intentionally
Blank

**Electrical
EICAS Messages****Chapter 6
Section 30****Electrical EICAS Alert Messages**

Message	Level	Aural	Message Logic
ELEC AC BUS L, R	Caution	Beeper	AC bus is unpowered.
ELEC BACKUP GEN L, R	Advisory		Backup generator has failed.
ELEC BACKUP SYS	Advisory		Backup power system has failed.
ELEC BATTERY OFF	Advisory		Battery switch is OFF.
ELEC BUS ISLN L, R	Advisory		Bus tie breaker is open due to an AC electrical system fault or Bus Tie switch is OFF.

[CABIN/UTILITY and IFE/PASS SEATS Power switches with AIMS Block Point 2001 or later Software Update]

ELEC CABIN/UTIL OFF	Advisory		Cabin/utility power switch is OFF.
---------------------	----------	--	------------------------------------

ELEC GEN DRIVE L, R	Advisory		Generator drive oil pressure is low.
ELEC GEN OFF APU	Advisory		APU generator control breaker is open.
ELEC GEN OFF L, R	Advisory		Generator control breaker is open.
ELEC GND HDLG BUS	Advisory		Ground handling bus relay has failed.

[CABIN/UTILITY and IFE/PASS SEATS Power switches with AIMS Block Point 2001 or later Software Update]

ELEC IFE/SEATS OFF	Advisory		In-flight entertainment system/passenger seats power switch is OFF.
--------------------	----------	--	---

ELEC STANDBY SYS	Advisory		A fault is detected in the standby power system.
------------------	----------	--	--

MAIN BATTERY DISCH	Advisory		Main battery is discharging or hot battery bus is unpowered.
-----------------------	----------	--	---

Engines, APU**Chapter 7****Table of Contents****Section 0**

Controls and Indicators	7.10
EICAS Display	7.10.1
Mode Indications	7.10.3
EPR Indications	7.10.4
EPR Indications (Alternate Mode)	7.10.5
N1 Indications	7.10.6
N1 Indications (Hard Alternate Mode)	7.10.6
N1 Indications (All Modes)	7.10.7
EGT Indications	7.10.9
In-Flight Start Envelope	7.10.10
Crossbleed Start Indications	7.10.12
Secondary Engine Indications	7.10.13
Secondary Engine Display	7.10.13
N2 Indications	7.10.15
N3 Indications	7.10.16
Fuel Flow Indications	7.10.17
Oil Pressure Indications	7.10.17
Oil Temperature Indications	7.10.19
Oil Quantity Indications	7.10.20
Engine Vibration Indications	7.10.21
Compact Engine Indications	7.10.23
Engine Controls	7.10.26
Thrust Levers	7.10.26
Fuel Control Switches	7.10.27
Engine Control Panel	7.10.28
Auxiliary Power Unit (APU)	7.10.30
APU Controls	7.10.30
APU Indications	7.10.31
Engine System Description	7.20
Introduction	7.20.1
Engine Intermix	7.20.2

Takeoff Bump Thrust Reference Mode	7.20.2
Engine Indications	7.20.2
Primary Engine Indications	7.20.2
Secondary Engine Indications	7.20.3
Normal Display Format	7.20.3
Compact Display Format	7.20.6
Electronic Engine Control (EEC)	7.20.7
EEC Normal Mode	7.20.7
EEC Alternate Mode	7.20.8
Overspeed Protection	7.20.9
EEC Idle Selection	7.20.9
Engine Start and Ignition System	7.20.10
Autostart	7.20.11
Autostart	7.20.12
Autostart	7.20.13
Manual Start	7.20.15
In-Flight Start	7.20.15
In-Flight Start	7.20.15
Engine Ignition	7.20.16
Auto-Relight	7.20.17
Engine Start and Ignition System Schematic	7.20.18
Engine Fuel System	7.20.19
Engine Fuel System Schematic	7.20.20
Engine Oil System	7.20.22
Engine Oil System Schematic	7.20.23
Thrust Reverser System	7.20.24
Thrust Reverser Schematic	7.20.26
Airborne Vibration Monitoring System	7.20.27
Engine Failure Alert System	7.20.28
APU System Description	7.30
Introduction	7.30.1
APU Operation	7.30.1
APU Start	7.30.1

777 Flight Crew Operations Manual

APU Automatic Start	7.30.2
APU Run	7.30.2
APU Shutdown	7.30.2
APU Operating Modes	7.30.2
EICAS Messages	7.40
Engines, APU EICAS Messages	7.40.1

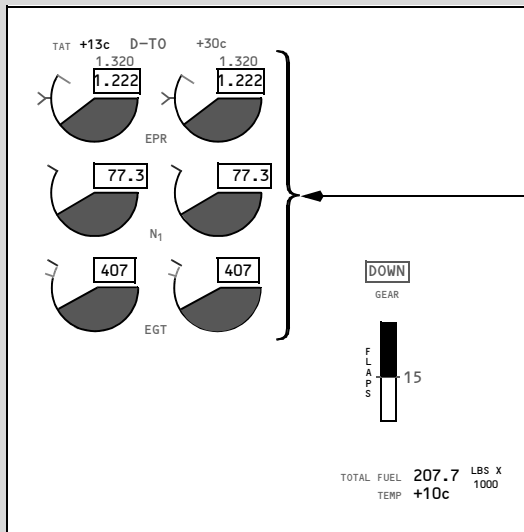
Intentionally
Blank

**Engines, APU
Controls and Indicators**

**Chapter 7
Section 10**

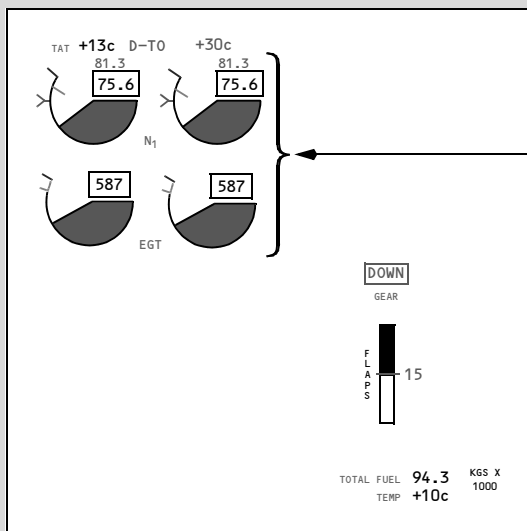
EICAS Display

[Options – PW, RR Engines, English Units]



UPPER CENTER DISPLAY

[Options – GE Engines, Metric Units]



UPPER CENTER DISPLAY

1 Primary Engine Indications

[PW, RR Engines]

Displayed full time on the EICAS display:

- EPR
- N1
- EGT.

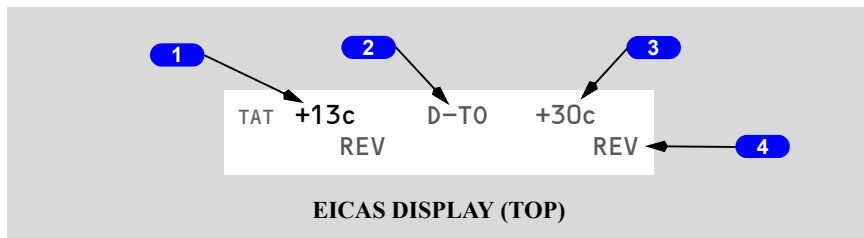
1 Primary Engine Indications

[GE Engines]

Displayed full time on the EICAS display:

- N1
- EGT.

Mode Indications



1 Total Air Temperature (TAT)

Displayed (white) – TAT (degrees C).

2 Thrust Reference Mode

[Option – Takeoff Derates]

Displayed (green) – selected FMS thrust reference mode:

- TO – maximum rated takeoff thrust
- TO 1 – derate one takeoff thrust
- TO 2 – derate two takeoff thrust
- D-TO – assumed temperature derated takeoff thrust
- D-TO 1 – derate one assumed temperature derated takeoff thrust
- D-TO 2 – derate two assumed temperature derated takeoff thrust
- CLB – maximum rated climb thrust
- CLB 1 – derate one climb thrust
- CLB 2 – derate two climb thrust
- CON – maximum rated continuous thrust
- CRZ – maximum rated cruise thrust
- G/A – maximum go-around thrust.

[Option]

- TO B – provides additional takeoff thrust. Refer to the Airplane Flight Manual (AFM) for the performance limitations and data required to use this feature.

[Option]

- A-TO, A-TO 1, A-TO 2, A-TO B – APU-to-Pack or APU-to-Pack derated or APU-to-Pack takeoff bump thrust

3 Assumed Temperature

Displayed (green) – selected assumed temperature (degrees C) for reduced thrust takeoff.

4 Thrust Reverser Indication

Displayed REV (amber) – reverser in transit.

Displayed REV (green) – reverser fully deployed.

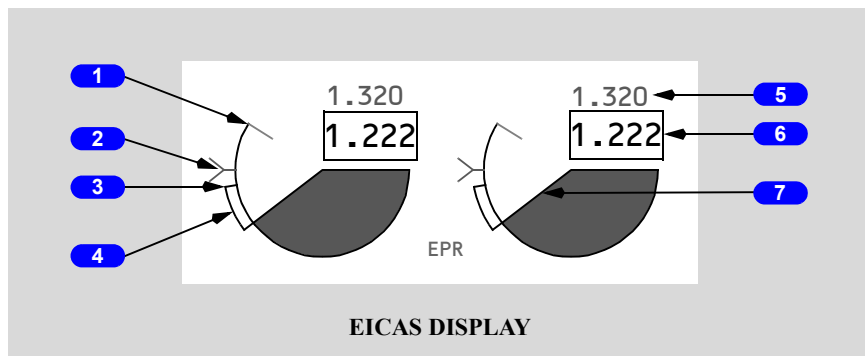
EPR Indications

[PW, RR Engines]

Note: During tailwind conditions, slight EPR fluctuations may occur prior to 5 knots forward airspeed.

Note: When reverse thrust is activated, the following indications are not displayed:

- maximum EPR line
- commanded EPR
- reference/target EPR indication
- reference EPR.



1 Maximum EPR Line

Displayed (amber).

2 Reference/Target EPR indication

Displayed (green) – reference EPR limit.

Displayed magenta – target FMC commanded EPR when VNAV is engaged and:

- the autothrottle is engaged in THR or THR REF mode, or
- the autothrottle is not engaged.

3 Commanded EPR

Displayed (white).

4 Commanded EPR Sector

Displays momentary difference between engine EPR and EPR commanded by thrust lever position.

5 Reference EPR

Displayed (green).

6 Actual EPR

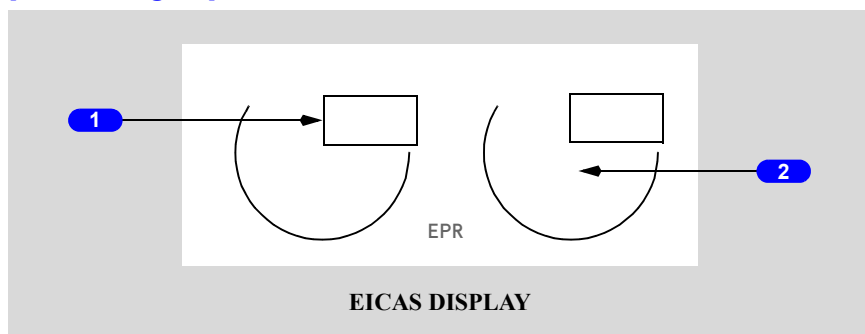
Displayed (white).

7 Actual EPR indication

Displayed (white).

EPR Indications (Alternate Mode)

[PW, RR Engines]

**1 EPR Indication**

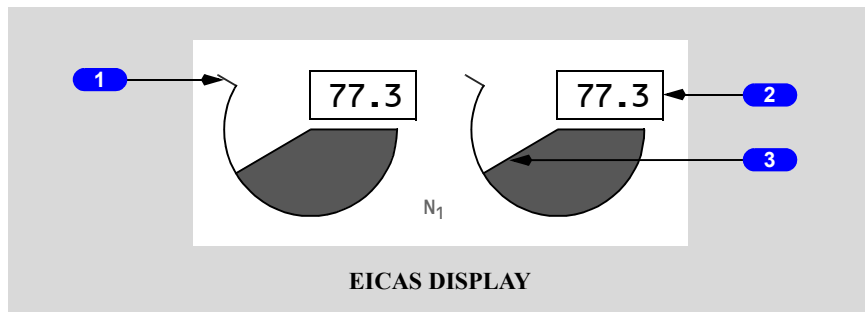
Displayed (blank).

2 Actual EPR Indication

Displayed (blank).

N1 Indications

[PW, RR Engines]



1 N1 Red Line

Displayed (red) – N1 RPM operating limit.

2 N1

Digital N1 RPM (%), displayed:

- (white) – normal operating range
- displayed (red) – operating limit reached.

3 N1 Indication

N1 RPM, displayed:

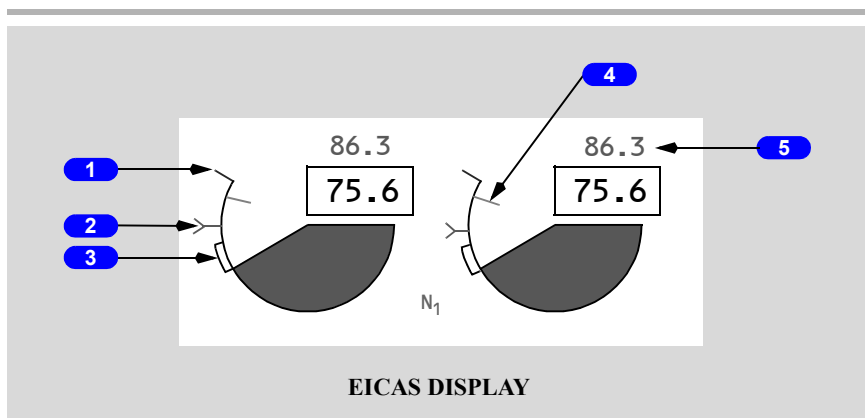
- (white) – normal operating range
- displayed (red) – operating limit reached.

N1 Indications (Hard Alternate Mode)

[PW, RR Engines]

Note: When reverse thrust is activated, the following indications are not displayed:

- maximum N1 line
- commanded N1
- reference/target N1 indication
- reference N1.

**1 N1 Red Line**

Displayed (red).

2 Reference/Target N1 Indication

Displayed (green) – reference N1 limit.

Displayed (magenta) – target FMC commanded N1 when VNAV is engaged and:

- the autothrottle is engaged in THR or THR REF mode, or
- the autothrottle is not engaged.

3 Commanded N1 Sector

Displays momentary difference between engine N1 and N1 commanded by thrust lever position.

4 Maximum N1 Line

Displayed (amber).

5 Reference N1

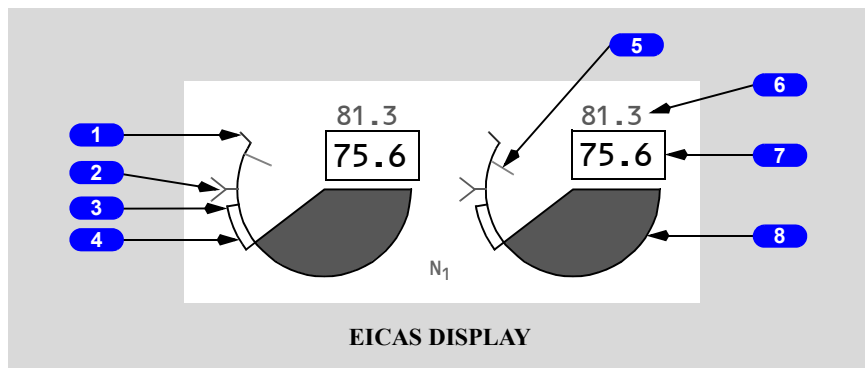
Displayed (green) – thrust reference calibrated for N1.

N1 Indications (All Modes)**[GE Engines]**

Note: When reverse thrust is activated, the following indications are not displayed:

- maximum N1 line
- commanded N1

- reference/target N1 indication
- reference N1.



1 N1 Red Line

Displayed (red) – N1 RPM operating limit.

2 Reference/Target N1

Displayed (green) – reference N1 limit.

Displayed (magenta) – target FMC commanded N1 when VNAV is engaged and:

- the autothrottle is engaged in THR or THR REF mode, or
- the autothrottle is not engaged.

3 Commanded N1

Displayed (white).

4 Commanded N1 Sector

Displays momentary difference between engine N1 and N1 commanded by thrust lever position.

5 Maximum N1 Line

Displayed (amber).

6 Reference N1

Displayed (digital, green).

7 N1

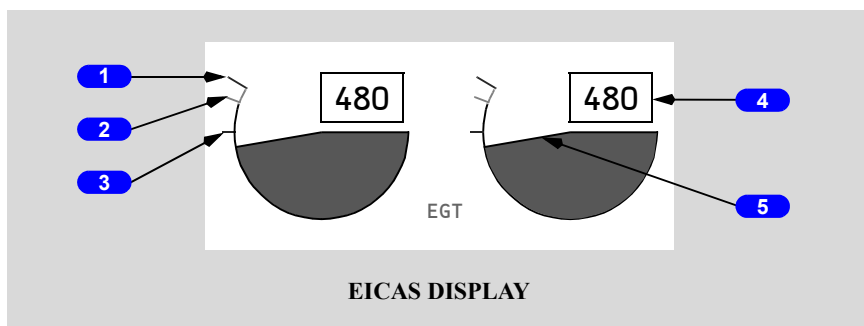
Digital N1% RPM, displayed:

- (white) – normal operating range
- displayed (red) – operating limit reached.

8 N1 Indication

N1 RPM, displayed:

- (white) – normal operating range
- displayed (red) – operating limit reached.

EGT Indications**1 EGT Red Line**

[GE, RR Engines]

Displayed (red) – maximum takeoff EGT limit.

1 EGT Red Line

[PW Engines]

Displayed (red) – maximum takeoff/in-flight start EGT limit.

2 EGT Amber Band

Displayed (amber) – maximum continuous EGT limit.

3 EGT Start Limit Line

[GE, RR Engines]

Displayed (red):

- with the FUEL CONTROL switch in CUTOFF, or

[GE Engines]

- with the N2 RPM below idle.

[RR Engines]

- with the N3 RPM below idle.

3 EGT Start Limit Line

[PW Engines]

Displayed (red):

- on the ground
- with the FUEL CONTROL switch in CUTOFF, or
- with the N2 RPM below idle.

4 EGT

EGT (degrees C), displayed:

- (white) – normal operating range
- (amber) – maximum continuous limit reached
- (red) – maximum start or takeoff limit reached.

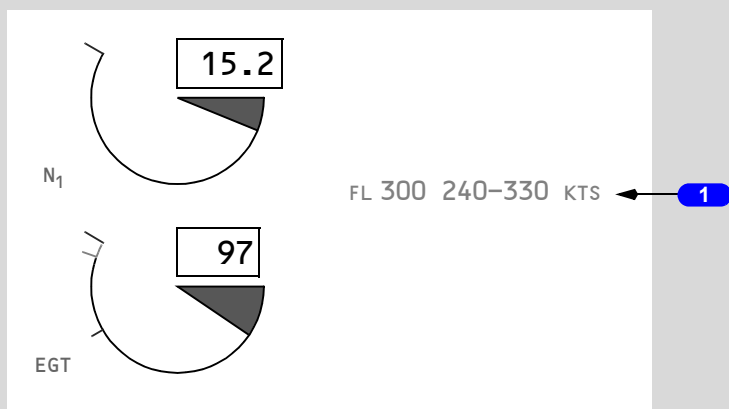
5 EGT Indication

Displayed:

- (white) – normal operating range
- (amber) – maximum continuous limit reached
- (red) – maximum start or takeoff limit reached.

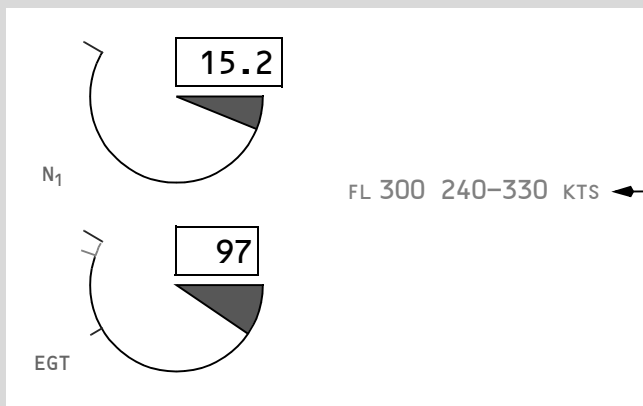
In-Flight Start Envelope

[RR Engines]



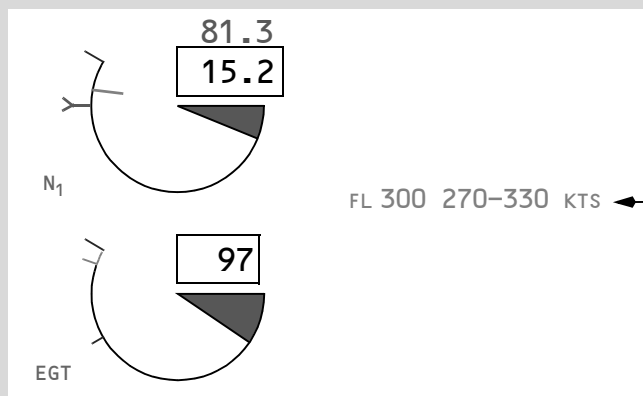
EICAS DISPLAY

[PW engines]



EICAS DISPLAY

[GE Engines]



EICAS DISPLAY

1 In-Flight Start Envelope

Displayed (magenta) – airspeed range for an in-flight start at the current flight level or maximum flight level (whichever is less) when the respective engine fire switch is in and:

- a FUEL CONTROL switch is in CUTOFF, or

[PW, GE Engines]

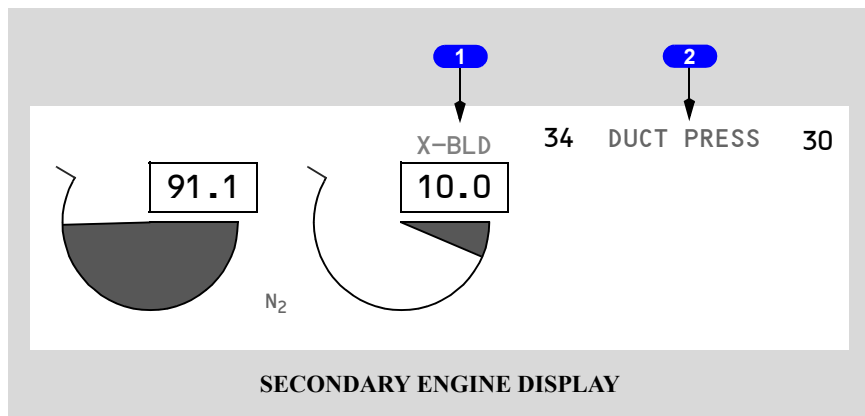
- engine N_2 RPM is below idle.

[RR Engines]

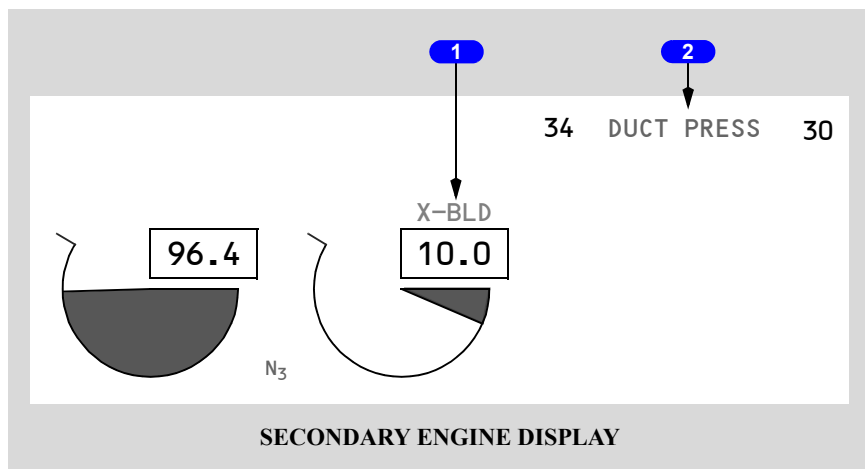
- engine N3 RPM is below idle.

Crossbleed Start Indications

[PW, GE Engines]



[RR Engines]



1 CROSSBLEED START Indication

Indicates crossbleed air is recommended for an in-flight start.

Displayed (magenta):

- the in-flight start envelope is displayed, and
- airspeed is lower than that for a windmilling start.

2 DUCT PRESSURE

Displayed (white numbers) – pressure in the left and right bleed air ducts in psi when the respective engine fire switch is in and:

- a FUEL CONTROL switch is in CUTOFF, and

[PW, GE Engines]

- engine N2 RPM is below idle.

[RR Engines]

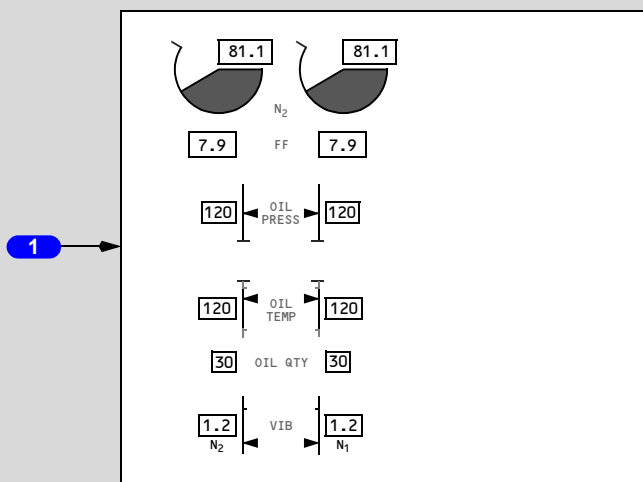
- engine N3 RPM is below idle.

Secondary Engine Indications

See Chapter 10, Flight Instruments, Displays, for display selection of Secondary Engine indications.

Secondary Engine Display

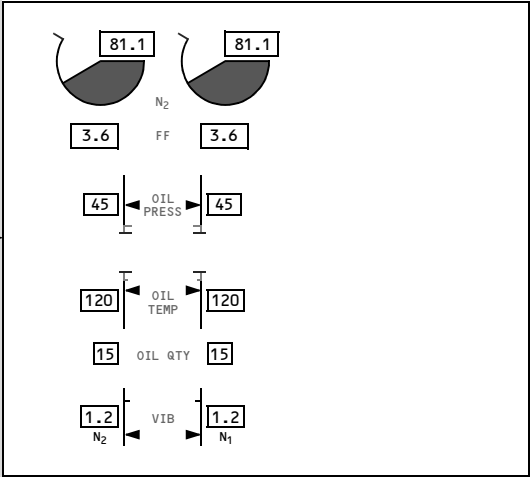
[Options – PW Engines, English Units]



MULTIFUNCTION DISPLAY

[Options – GE Engines, Metric Units]

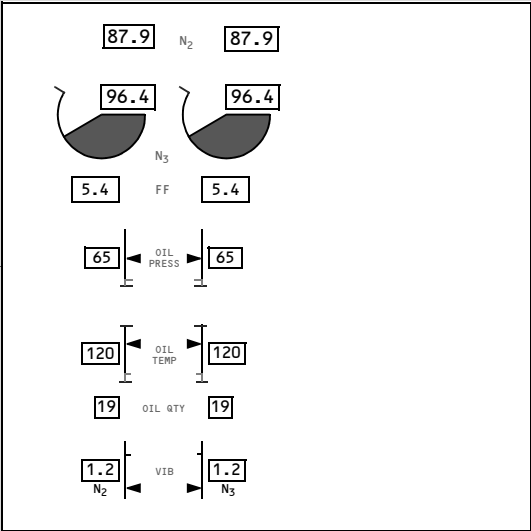
1



MULTIFUNCTION DISPLAY

[Options – RR Engines, Metric Units]

1



MULTIFUNCTION DISPLAY

1 Secondary Engine Display**[PW, GE Engines]**

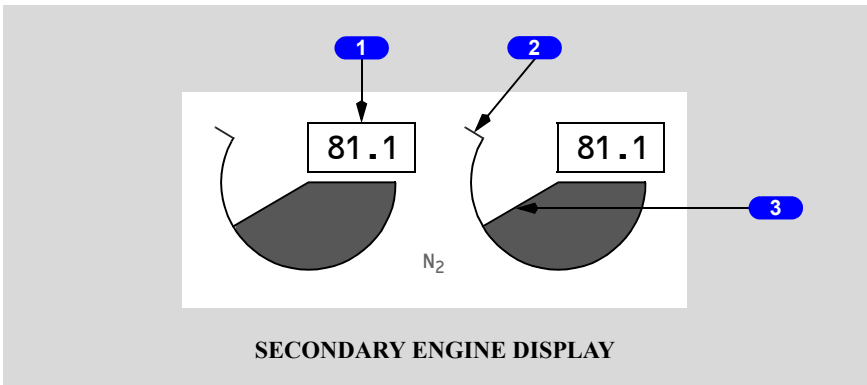
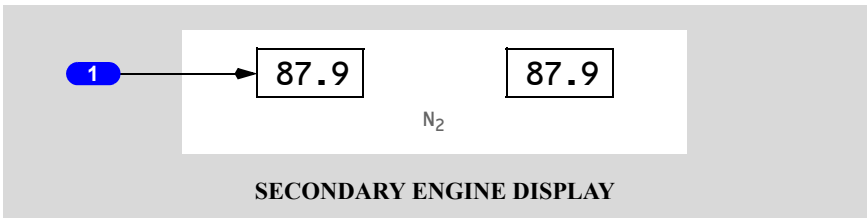
Displays:

- N2 RPM
- fuel flow (FF)
- oil pressure
- oil temperature
- oil quantity
- vibration.

1 Secondary Engine Display**[RR Engines]**

Displays:

- N2 RPM
- N3 RPM
- fuel flow (FF)
- oil pressure
- oil temperature
- oil quantity
- vibration.

N2 Indications**[PW, GE Engines]****[RR Engines]**

1 N2

N2 RPM (%), displayed:

- (white) – normal operating range
- (red) – operating limit reached.

2 N2 Red Line

N2 RPM operating limit, displayed (red).

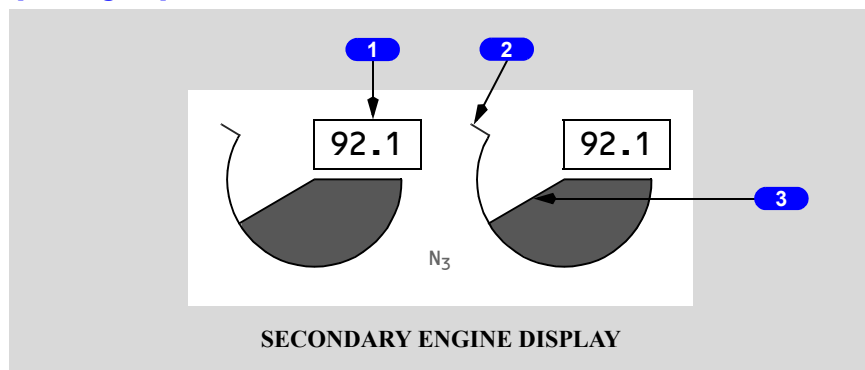
3 N2 Indication

N2 RPM, displayed:

- (white) – normal operating range
- (red) – operating limit reached.

N3 Indications

[RR Engines]



1 N3

N3 RPM (%), displayed:

- (white) – normal operating range
- (red) – operating limit reached.

2 N3 Red Line

N3 RPM operating limit, displayed (red).

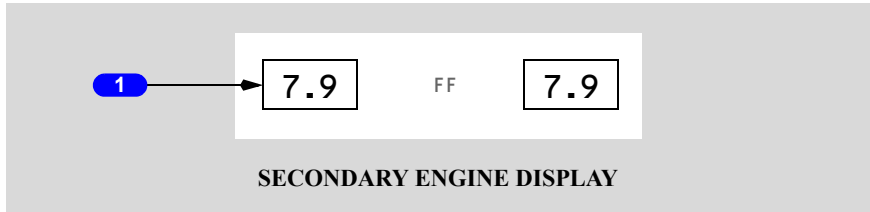
3 N3 Indication

N3 RPM, displayed:

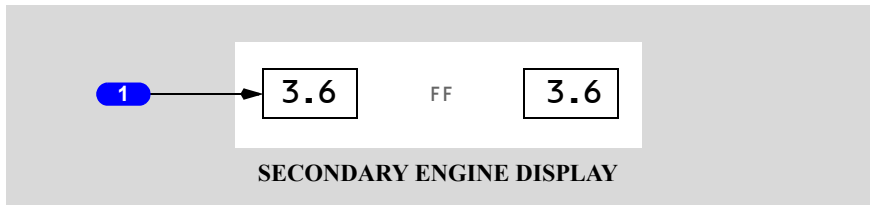
- (white) – normal operating range
- (red) – operating limit reached.

Fuel Flow Indications

[Option – English Units]



[Option – Metric Units]



1 Fuel Flow

[English Units]

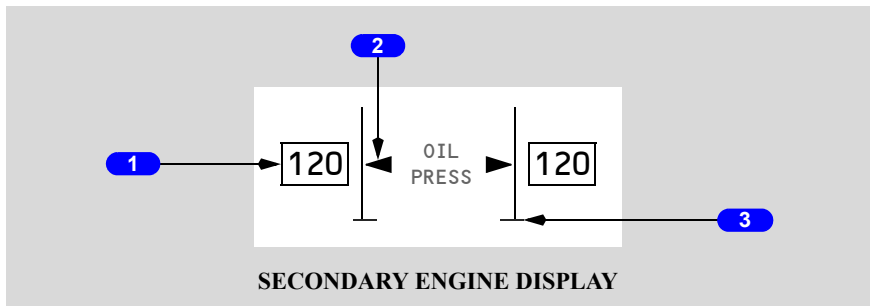
Displayed (white) – fuel flow to the engine (pounds per hour x 1000).

[Metric Units]

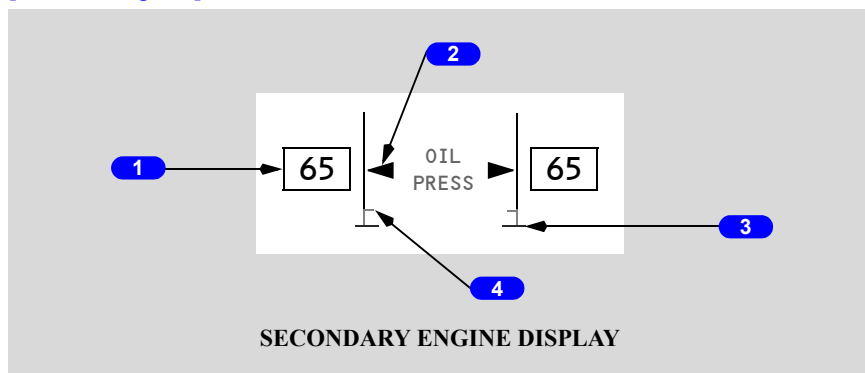
Displayed (white) – fuel flow to the engine (kilograms per hour x 1000).

Oil Pressure Indications

[PW Engines]



[GE, RR Engines]



1 Oil Pressure

[PW Engines]

Engine oil pressure (psi), displayed:

- (white) – normal operating range
- (red) – operating limit reached.

1 Oil Pressure

[GE, RR Engines]

Engine oil pressure (psi), displayed:

- (white) – normal operating range
- (amber) – caution range reached
- (red) – operating limit reached.

2 Oil Pressure Pointer

[PW Engines]

Engine oil pressure, displayed:

- (white) – normal operating range
- (red) – operating limit reached.

2 Oil Pressure Pointer

[GE, RR Engines]

Engine oil pressure, displayed:

- (white) – normal operating range
- (amber) – caution range reached
- (red) – operating limit reached.

3 Oil Pressure Red Line

Displayed (red) – oil pressure operating limit.

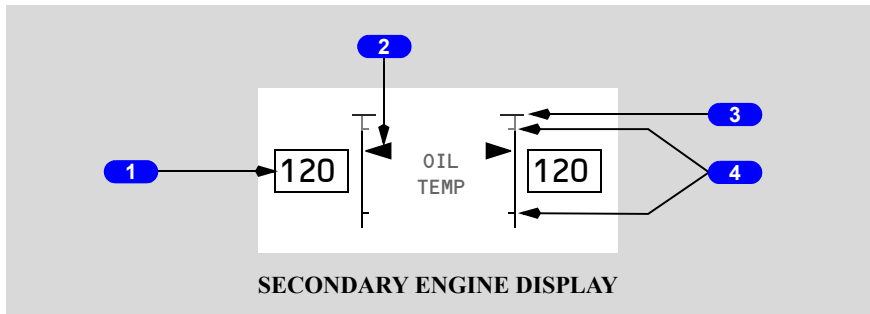
4 Oil Pressure Amber Band

[GE, RR Engines]

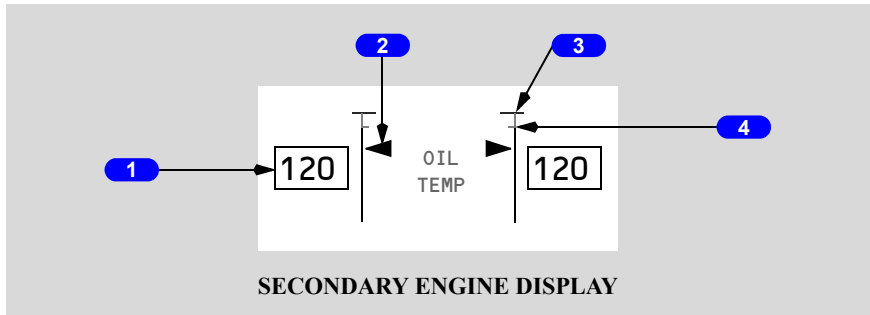
Displayed (amber) – oil pressure caution range.

Oil Temperature Indications

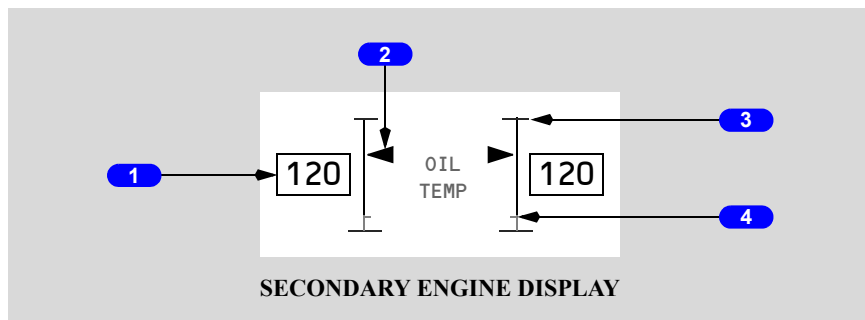
[PW Engines]



[GE Engines]



[RR Engines]



1 Oil Temperature

Engine oil temperature (degrees C), displayed:

- (white) – normal operating range
- (amber) – caution range reached
- (red) – operating limit reached.

2 Oil Temperature Pointer

Engine oil temperature, displayed:

- (white) – normal operating range
- (amber) – caution range reached
- (red) – operating limit reached.

3 Oil Temperature Red Line

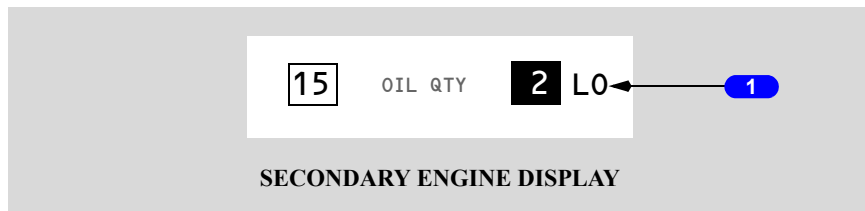
Displayed (red) – oil temperature operating limit.

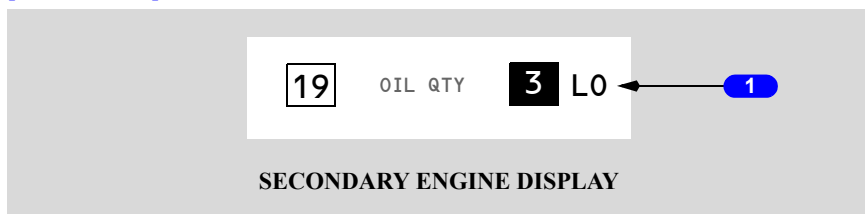
4 Oil Temperature Amber Band

Displayed (amber) – oil temperature caution range.

Oil Quantity Indications

[English Units]



[Metric Units]**1 Oil Quantity****[English Units]**

Usable oil quantity (quarts).

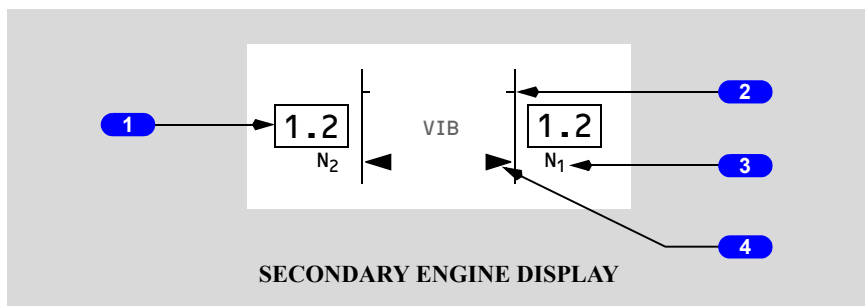
[Metric Units]

Usable oil quantity (liters).

Displayed:

- (white) – normal quantity
- (reverses the display to show black numbers on white background) – low quantity.

Note: LO – displayed (white) when quantity is low.

Engine Vibration Indications**1 Engine Vibration**

Engine vibration, displayed:

- (white) – normal operating range
- (black numbers, white background) – high vibration.

2 Engine Vibration High Band

Displayed (white) – vibration level at which automatic display of secondary engine indications occurs.

3 Vibration Source

Identifies the vibration source being displayed.

Displayed (white) – vibration source with the highest vibration:

- N1 rotor vibration
- N2 rotor vibration.

[\[RR Engines\]](#)

- N3 rotor vibration.

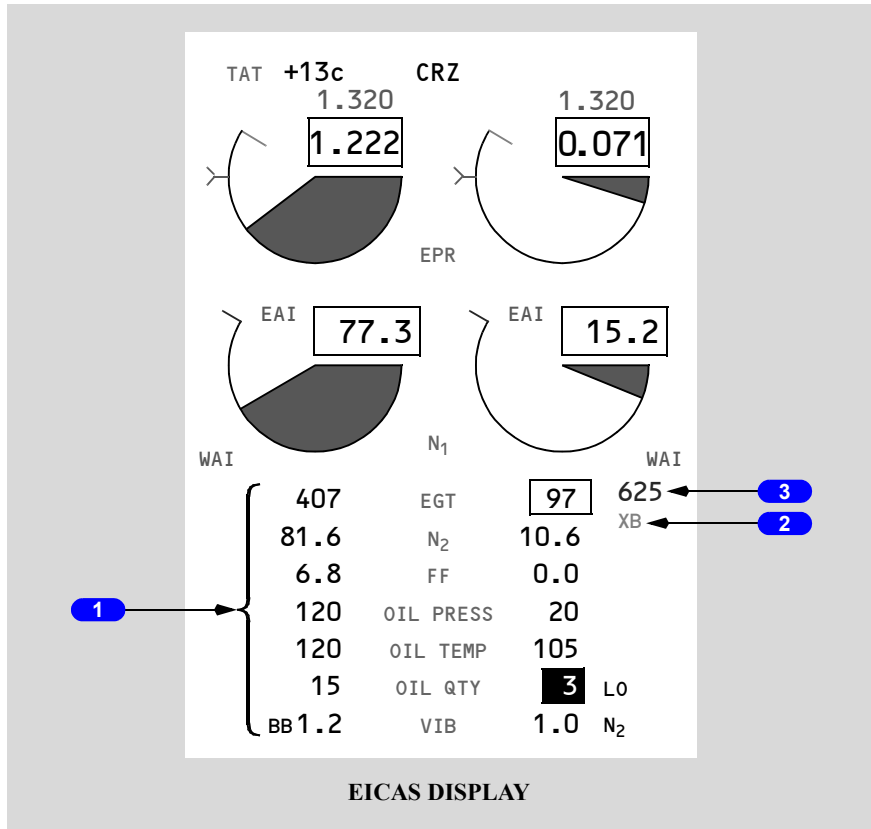
If the vibration source BB (broad band vibration) is displayed, the source is unknown and average vibration is displayed.

4 Engine Vibration Pointer

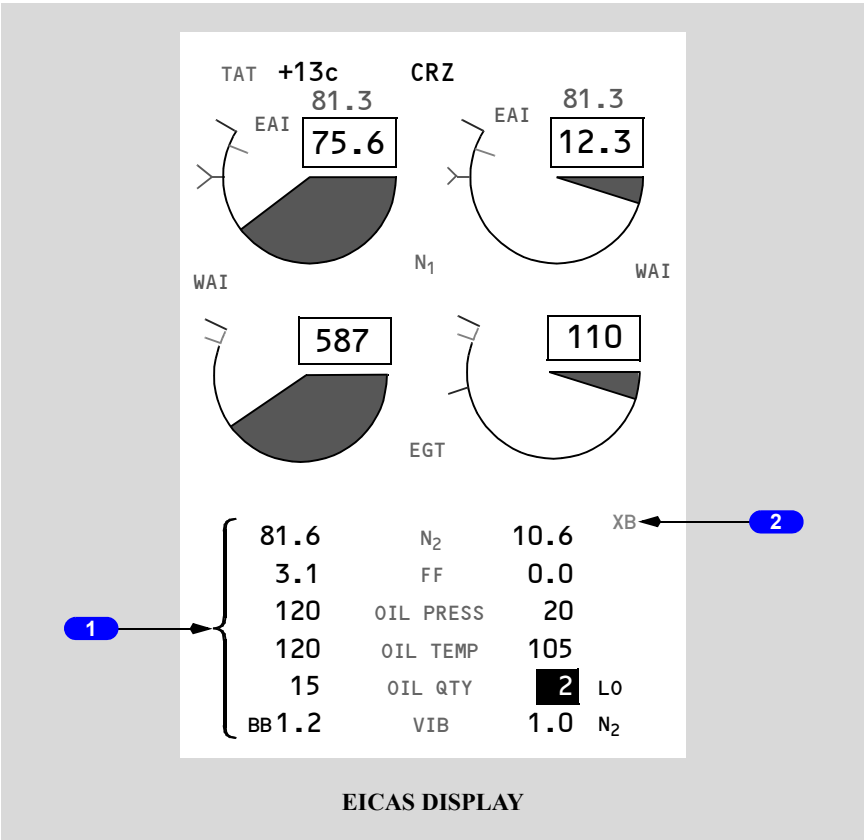
Displayed (white) – engine vibration.

Compact Engine Indications

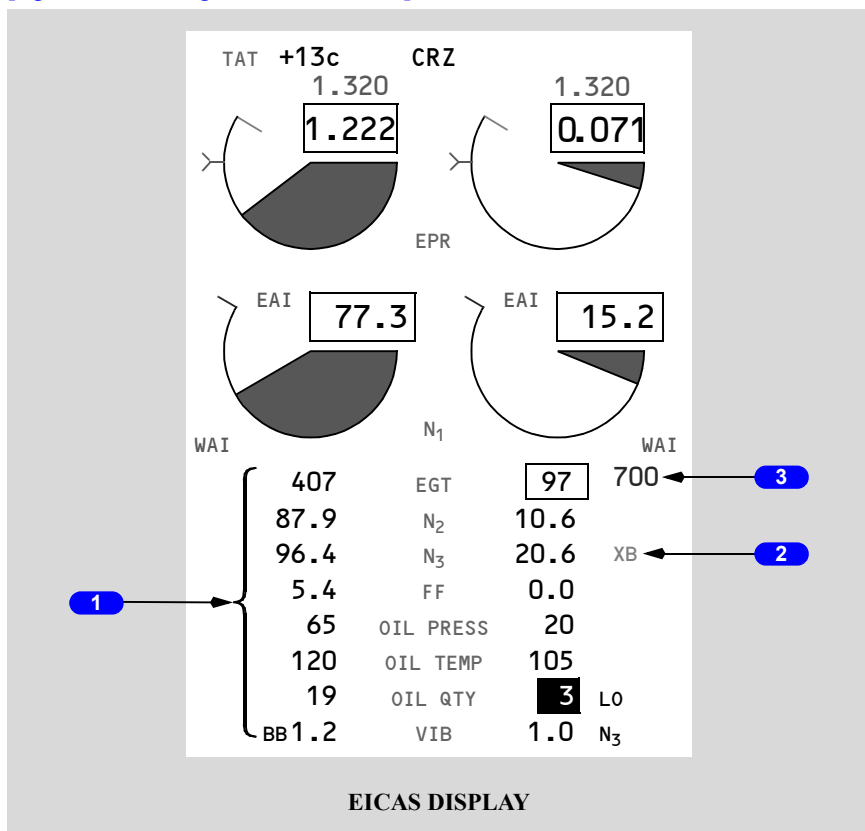
[Options – PW Engines, English Units]



[Options – GE Engines, Metric Units]



EICAS DISPLAY

[\[Options – RR Engines, Metric Units\]](#)**1 Compact Engine Indications**

The following changes to EICAS and the normal secondary engine display occur:

[\[GE Engines\]](#)

- N₂ changes from round dial displays to a digital display. The digital display is framed by an amber or red box if limits are exceeded.

[\[PW Engines\]](#)

- EGT and N₂ change from round dial displays to digital displays. The digital displays are framed by an amber or red box if limits are exceeded.

[\[RR Engines\]](#)

- EGT and N₃ change from round dial displays to digital displays. The digital displays are framed by an amber or red box if limits are exceeded.

- FF, OIL PRESS, OIL TEMP are displayed as digital readouts only. The digital displays turn amber or red if limits are exceeded.
- OIL QTY and VIB are displayed as digital readouts only. Low oil quantity and high vibrations are displayed the same as in the normal format.

2 Crossbleed start indication

Displayed (magenta).

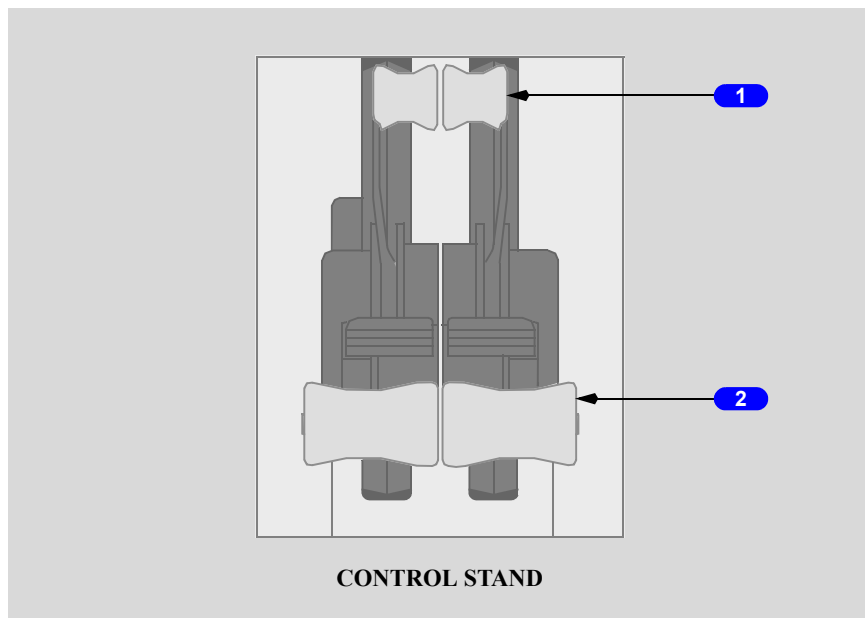
3 EGT start limit

[PW, RR Engines]

Displayed (red).

Engine Controls

Thrust Levers



1 Reverse Thrust Levers

Control engine reverse thrust.

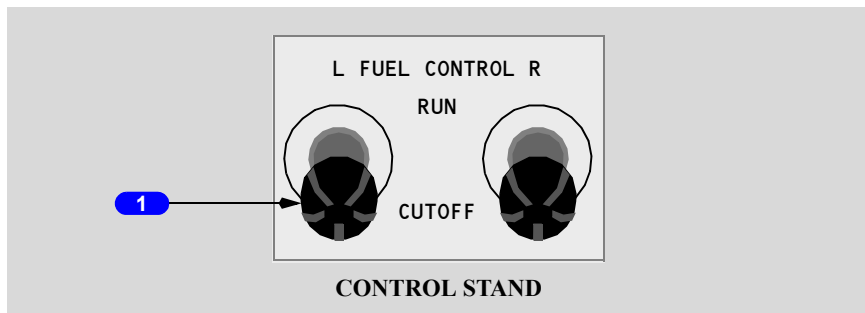
Reverse thrust can only be selected when the forward thrust levers are closed.

Actuates automatic speedbrakes (refer to Chapter 9, Flight Controls).

2 Forward Thrust Levers

Controls engine forward thrust.

The thrust levers can only be advanced if the reverse thrust levers are down.

Fuel Control Switches**1 FUEL CONTROL Switch**

RUN (AUTOSTART ON) –

- Opens the spar fuel valve
- arms the engine fuel valve (the EEC opens the valve when required)
- arms the selected ignitors (the EEC turns the ignitors on when required).

RUN (AUTOSTART OFF) –

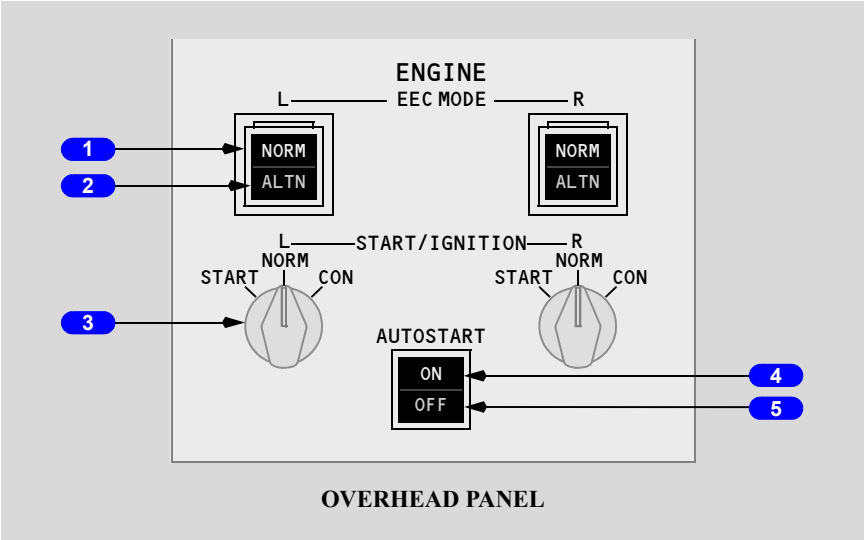
- opens the spar fuel valve
- opens the engine fuel valve
- turns ignitors on.

CUTOFF –

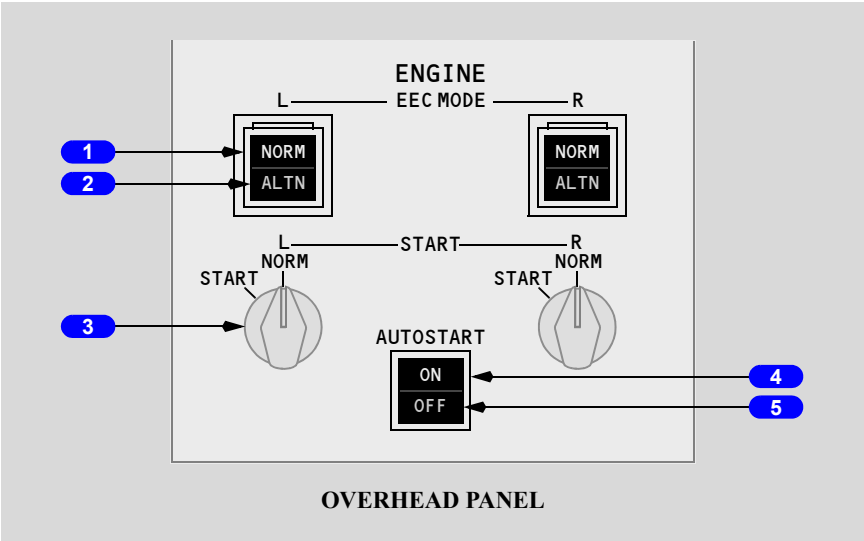
- closes the fuel valves
- removes ignitor power
- unlocks the engine fire switch.

Engine Control Panel

[PW, GE Engines with CON IGN position]



[RR Engines, GE Engines without CON IGN position]



1 Electronic Engine Control (EEC) Mode Switch

NORM –

- selects the normal engine control mode for engine control
- [GE Engines]
- the EEC sets thrust using N1 RPM as the controlling parameter.
- [PW, RR Engines]
- the EEC sets thrust using EPR as the controlling parameter.

Off (ALTN visible) –

- selects the alternate engine control mode for engine control
- thrust is set using N1 RPM as the controlling parameter.

2 Electronic Engine Control (EEC) Alternate (ALTN) Light

Illuminated (amber) – the alternate engine control mode is either automatically or manually selected.

3 START/IGNITION Selector

[PW Engines]

START –

- initiates engine start by opening the start valve
- releases to NORM at start valve cutout.

NORM –

- the start valve closes
- automatic ignition is provided for both ignitors (if the FUEL CONTROL switch is in RUN)
- automatic ignition operates both ignitors continuously for the following conditions:
 - the flap lever is out of the up position, or
 - engine anti-ice is on.

CON – both ignitors operate continuously (if the FUEL CONTROL switch is in RUN).

3 START/IGNITION Selector

[GE Engines with CON IGN position]

START –

- initiates engine start by opening the start valve
- releases to NORM at start valve cutout.

NORM –

- the start valve closes
- ignition is automatically provided during engine start-up or if engine flameout occurs (if the FUEL CONTROL switch is in RUN).

CON – both ignitors operate continuously in flight, or on the ground above 60% N1 with takeoff flaps set, (if the FUEL CONTROL switch is in RUN).

3 START Selector

[RR Engines]

START –

- initiates engine start by opening the start valve
- releases to NORM at start valve cutout.

NORM – the start valve closes.

4 AUTOSTART Switch

ON – arms the autostart system.

OFF –

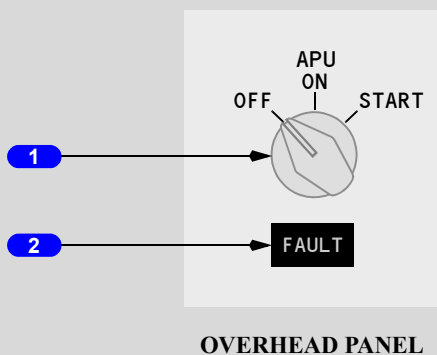
- the autostart system is disabled
- the start is manually controlled.

5 AUTOSTART OFF Light

Illuminated (amber) – the AUTOSTART switch is OFF.

Auxiliary Power Unit (APU)

APU Controls



1 APU Selector

OFF –

- closes the APU bleed air isolation valve
- initiates normal shutdown
- resets auto shutdown fault logic.

ON (APU operating position) –

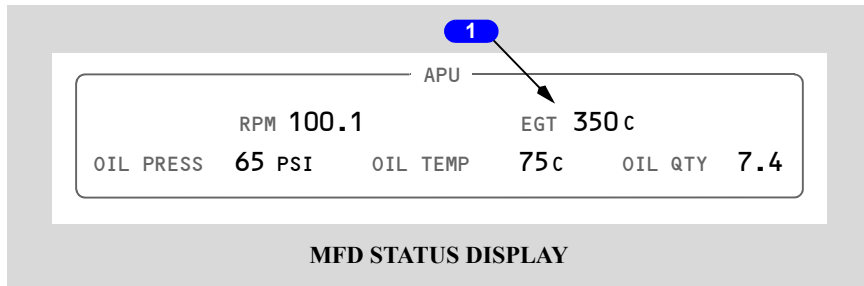
- opens the APU fuel valve and inlet door
- activates AC or DC fuel pump
- powers the APU controller.

START (momentary position, spring-loaded to ON) – initiates automatic start sequence.

2 APU FAULT Light

Illuminated (amber):

- APU fault and/or fire is detected
- APU shutdown due to fault and/or fire
- momentarily during APU controller self-test.

APU Indications**1 APU Status Display**

RPM – APU rotation speed in percent RPM.

EGT – APU exhaust gas temperature.

OIL PRESS – APU oil pressure in PSI.

OIL TEMP – APU oil temperature.

[\[English Units\]](#)

OIL QTY – APU oil quantity (quarts).

[\[Metric Units\]](#)

OIL QTY – APU oil quantity (liters).

Intentionally
Blank

Engines, APU Engine System Description

Chapter 7 Section 20

Introduction

The following optional engines may be installed on 777 airplanes. General Electric (GE), Pratt and Whitney (PW), and Rolls Royce Trent (RR) model engines are shown. The rated takeoff thrust in pounds for each engine is shown in (parentheses).

- PW4074 (74,500)
- PW4077 (77,200)
- PW4084 (84,000)
- PW4090 (90,000)
- PW4098 (98,000)
- GE90-76B (76,400)
- GE90-77B (77,400)
- GE90-85B (85,000)
- GE90-90B (90,000)
- GE90-94B (94,000)
- GE90-110B1L (110,000)
- GE90-115B (115,000)
- RR Trent 875 (73,400)
- RR Trent 877 (76,900)
- RR Trent 884 (84,000)
- RR Trent 892 (90,000)
- RR Trent 895 (93,400)

[PW, GE Engines]

The engines are dual rotor axial flow turbofans of high compression and bypass ratio. The N1 rotor consists of a fan, a low pressure compressor section, and a low pressure turbine section on a common shaft. The N2 rotor consists of a high pressure compressor section and a high pressure turbine section on a common shaft. The N1 and N2 rotors are mechanically independent. The N2 rotor drives the engine accessory gearbox.

[RR Engines]

The engines are three-rotor axial flow turbofans of high compression and bypass ratio. The N1 rotor consists of the fan and a low pressure turbine section on a common shaft. The N2 rotor consists of an intermediate pressure compressor section and an intermediate pressure turbine section on a common shaft. The N3 rotor consists of a high pressure compressor section and a high pressure turbine section on common shaft. The N1, N2, and N3 rotors are mechanically independent. The N3 rotor drives the engine accessory gearbox.

Each engine is controlled by an EEC. The EECs monitor autothrottle and flight crew inputs through the thrust levers to automatically control the engines.

Each engine has individual flight deck controls. Thrust is set by positioning the thrust levers. The thrust levers are positioned automatically by the autothrottle system or manually by the flight crew. See Chapter 11, Flight Management, Navigation, Section 32, for a description of FMC thrust management functions.

Engine indications are displayed on the EICAS display.

Engine Intermix

[GE Engines]

Both engines are set to operate at the same thrust rating. Replacement engine thrust rating is increased or decreased to match the thrust rating of the installed engine configuration. An EGT amber band (maximum continuous limit) difference between engines may be indicated, but these indications are normal.

[PW Engines]

Both engines are set to operate at the same thrust rating. Replacement engine thrust rating is increased or decreased to match the thrust rating of the installed engine configuration. An EGT red line (maximum takeoff EGT limit) difference between the engines may be indicated, but these indications are normal.

Takeoff Bump Thrust Reference Mode

[Option]

Takeoff bump (when use is approved) can be selected on the CDU THRUST LIM page. When selected, TO B is displayed as the EICAS thrust reference mode.

Takeoff bump thrust is also available whenever the airplane is in the takeoff bump region (altitude and ambient temperature range). If the thrust levers are manually positioned full forward while in the takeoff bump region, the EECs will allow thrust to increase up to the takeoff bump rating even though another thrust limit is selected on the CDU THRUST LIM page.

Engine Indications

Primary and secondary engine indications are provided. Engine indications are displayed on the EICAS display and any selected MFD.

Primary Engine Indications

[PW, RR Engines]

EPR, N1, and EGT are the primary engine indications. The primary engine indications are always displayed on the EICAS display. Normally the EICAS is on the upper center display unit. If that unit fails the EICAS display automatically moves to the lower center display unit.

[GE Engines]

N1 and EGT are the primary engine indications. The primary engine indications are always displayed on the EICAS display. Normally the EICAS is on the upper center display unit. If that unit fails, the EICAS display automatically moves to the lower center display unit.

Secondary Engine Indications

[PW, GE Engines]

N2, fuel flow, oil pressure, oil temperature, oil quantity, and engine vibration are secondary engine indications. Secondary engine indications are displayed on the selected MFD. The secondary engine indications can be displayed by pushing the secondary engine display switch (the ENG switch on the display select panel). The secondary engine indications are automatically displayed when:

- the displays initially receive electrical power
- a FUEL CONTROL switch is moved to CUTOFF in flight
- an engine fire switch is pulled in flight
- a secondary engine parameter is exceeded, or
- engine N2 RPM is below idle in flight.

[RR Engines]

N2, N3, fuel flow, oil pressure, oil temperature, oil quantity, and engine vibration are secondary engine indications. Secondary engine indications are displayed on the selected MFD. The secondary engine indications can be displayed by pushing the secondary engine display switch (the ENG switch on the display select panel). The secondary engine indications are automatically displayed when:

- the displays initially receive electrical power
- a FUEL CONTROL switch is moved to CUTOFF in flight
- an engine fire switch is pulled in flight
- a secondary engine parameter is exceeded, or
- engine N3 RPM is below idle in flight.

When the secondary engine parameters are automatically displayed (on the lower MFD, if available) due to any of the above conditions, they cannot be cleared until the condition is no longer present. Once the condition is no longer present, the secondary engine parameters can be cleared by pushing the secondary engine display switch.

Normal Display Format

[PW, GE Engines]

Primary engine indications and the N2 indications are both digital readouts and round dial/moving pointer indications. The digital readouts display numerical values while the moving pointers indicate relative value.

[RR Engines]

Primary engine indications and the N3 indication are digital readouts and round dial/moving pointer indications. The digital readouts display numerical values while the moving pointers indicate relative value.

[PW, GE Engines]

Oil pressure, oil temperature, and vibration indications are both digital readouts and vertical indication/moving pointers. Fuel flow and oil quantity are digital readouts only. All digital readouts are enclosed by boxes. The dial and vertical indications display the normal operating range, caution range, and operating limits (as applicable).

[RR Engines]

Oil pressure, oil temperature, and vibration indications are both digital readouts and vertical indication/moving pointers. Fuel flow, N2, and oil quantity are digital readouts only. All digital readouts are enclosed by boxes. The dial and vertical indications display the normal operating range, caution range, and operating limits (as applicable).

Normal operating range is displayed on a dial or vertical indication in white.

[PW Engines]

The oil temperature vertical indication has caution ranges displayed by amber bands. If oil temperature reaches the caution range, the digital readout, digital readout box, and pointer all change color to amber.

[GE, RR Engines]

The oil temperature and oil pressure vertical indication has caution ranges displayed by amber bands. If oil temperature or oil pressure reaches the caution range, the digital readout, digital readout box, and pointer all change color to amber.

[PW, GE Engines]

N1, N2, EGT, oil pressure, and oil temperature indications have operating limits indicated by red lines. If one of these indications reaches the red line, the digital readout, box, and pointer change color to red for that indication.

[RR Engines]

N1, EGT, N3, oil pressure, and oil temperature indications have operating limits indicated by red lines. If one of these indications reaches the red line, the digital readout, box, and pointer change color to red for that indication.

[Option – 5 Minute Takeoff Inhibit]

The EGT indication has a maximum continuous limit represented by an amber band. The maximum continuous limit does not apply during takeoff or go-around. If EGT reaches the maximum continuous limit, the digital indication, box, pointer, and dial all change color to amber. EGT indications are inhibited from changing to amber during takeoff or go-around for five minutes. The EGT indication is often in the amber band during takeoff; this is acceptable. The EGT indication has a maximum takeoff limit displayed by a red line. If EGT reaches the maximum takeoff limit, the digital indication, box, pointer and dial, all change color to red.

[Option – 10 Minute Takeoff Inhibit]

The EGT indication has a maximum continuous limit represented by an amber band. The maximum continuous limit does not apply during takeoff or go-around. If EGT reaches the maximum continuous limit, the digital indication, box, pointer, and dial all change color to amber. EGT indications are inhibited from changing to amber during takeoff or go-around for five minutes. The EGT indication is often in the amber band during takeoff; this is acceptable. The inhibit is extended to ten minutes for single-engine operation. The EGT indication has a maximum takeoff limit displayed by a red line. If EGT reaches the maximum takeoff limit, the digital indication, box, pointer and dial, all change color to red.

[PW, GE Engines]

If an N1, N2, or EGT red line is exceeded, the box enclosing the digital readout remains red after the exceeded limit returns to the normal range. The red box color can be canceled to white or recalled to red by pushing the cancel/recall switch on the display select panel. An indication changes color back to white when it returns to the normal operating range.

[RR Engines]

If an N1, N3, or EGT red line is exceeded, the box enclosing the digital readout remains red after the exceeded limit returns to the normal range. The red box color can be canceled to white or recalled to red by pushing the cancel/recall switch on the display select panel. An indication changes color back to white when it returns to the normal operating range.

For low oil quantity, the oil quantity digital readout changes to black text on a white background. The white text LO is displayed adjacent to the readout.

For high engine vibration, the vibration digital readout changes to black text on a white background.

[PW, RR Engines]

The maximum EPR limit is indicated by an amber line at the top of the EPR dial. The EPR indication does not change color when maximum EPR is reached. The reference/target EPR indication displays the FMS reference or target EPR. The commanded EPR indication displays the EEC calculated EPR commanded by thrust lever position.

Compact Display Format

[PW Engines]

In compact format, primary and secondary engine indications are combined on the same display. The EPR and N1 displays are the same as the normal displays. All other indications change to digital readouts only. If an amber or red line parameter for a digital indication is exceeded, the digital indication changes color to amber or red (as does the box that appears around an EGT, or N2 indication for a red line exceedance). If the EGT or N2 red line is exceeded, the red color of the box around the digital indication can be returned to white (if the exceeded parameter has returned to normal) by pushing the display select panel CANCEL/RECALL switch.

[GE Engines]

In compact format, primary and secondary engine indications are combined on the same display. The N1 and EGT indications are displayed as they are normally (moving pointer/round dial and digital indications). All other indications change to digital readouts only, with the exception that the N2 digital readout is boxed if a parameter is exceeded. If an amber or red line parameter for a digital indication is exceeded, the digital indication changes color to amber or red (as does the box that appears around the N2 indication for a red line exceedance). If the N2 red line is exceeded, the red color of the box around the digital indication can be returned to white (if the exceeded parameter has returned to normal) by pushing the display select panel CANCEL/RECALL switch.

[RR Engines]

In compact format, primary and secondary engine indications are combined on the same display. The EPR and N1 displays are the same as the normal displays. All other indications change to digital readouts only. If an amber or red line parameter for a digital indication is exceeded, the digital indication changes color to amber or red (as does the box that appears around an EGT, N2, or N3 indication). If the N1, N2, N3, or EGT red line is exceeded, the red color of the box around the digital indication can be returned to white (if the exceeded parameter has returned to normal) by pushing the display select panel CANCEL/RECALL switch.

Primary and secondary engine indications are displayed on EICAS in compact format whenever:

- secondary engine display is automatically selected, and the lower multifunction display is failed, unpowered, or is occupied, or
 - secondary engine display is manually selected to the lower center MFD and the lower MFD is failed, unpowered, or occupied with EICAS.
-

Electronic Engine Control (EEC)

[\[PW, RR Engines\]](#)

Each EEC has full authority over engine operation. The EEC uses thrust lever inputs to automatically control forward thrust and reverse thrust. The EEC has two control modes: normal and alternate. In the normal mode, the EEC uses EPR as the parameter for setting thrust. In the alternate mode, the EEC uses N1 RPM as the controlling parameter.

[\[PW Engines\]](#)

At altitudes of 17,000 feet and above, compressor stall protection logic causes the engines to accelerate slowly if the acceleration is initiated shortly after a deceleration. The engines may accelerate at slightly different rates. Thrust asymmetry compensation (TAC) may activate.

[\[GE Engines\]](#)

Each EEC has full authority over engine operation. The EEC uses thrust lever inputs to automatically control forward thrust and reverse thrust. The EEC has two control modes: normal and alternate. In both normal and alternate modes, the EEC uses N1 RPM as the parameter for setting thrust.

EEC Normal Mode

[\[PW, RR Engines\]](#)

In the normal mode, the EEC sets thrust by controlling EPR based on thrust lever position. EPR is commanded by positioning the thrust levers either automatically with the autothrottles, or manually by the flight crew.

[\[GE Engines\]](#)

In the normal mode, the EEC sets thrust by controlling N1 based on thrust lever position. N1 is commanded by positioning the thrust levers either automatically with the autothrottles, or manually by the flight crew.

[\[PW, RR Engines\]](#)

Maximum EPR represents the maximum rated thrust available from the engine. The EEC continuously computes maximum EPR.

[GE Engines]

Maximum N1 represents the maximum rated thrust available from the engine. The EEC continuously computes maximum N1.

Maximum rated thrust is available in any phase of flight by moving the thrust levers to the full forward positions.

EEC Alternate Mode

If the required signals are not available to operate in the normal mode, the EEC automatically uses the alternate mode. In the alternate mode, the EEC schedules N1 as a function of thrust lever position. The alternate mode provides soft and hard levels of control:

- Soft – When the EEC automatically switches an engine to the alternate mode and the EEC mode switch remains in NORM, the EEC is in the soft alternate mode (the switch position is NORM, the EEC mode is alternate). At a fixed thrust lever position, thrust does not change.
- Hard – When ALTN is manually selected on an EEC mode switch, that engine is switched to the hard alternate mode (the switch position is ALTN, the EEC mode is alternate). Reference and target N1, and maximum and commanded N1 values are displayed on the N1 indication during the hard alternate mode. Thrust may change to set the commanded N1 when ALTN is manually selected.

[PW, RR Engines]

For the normal, soft alternate, and hard alternate modes, the following EPR and N1 information is displayed:

EEC mode switch – NORM EEC mode – Normal	EEC mode switch – NORM EEC mode – Soft Alternate	EEC mode switch – ALTN EEC mode – Hard Alternate
• EPR: actual, command, reference/target, maximum • N1: actual, red line.	• EPR: blank • N1: actual, red line.	• EPR: blank • N1: actual, command, reference/target, maximum, red line.

[GE Engines]

For the normal, soft alternate, and hard alternate modes, actual, command, reference/target, maximum, and red line N1 information is displayed.

Automatic reversion or manual selection to the alternate mode is indicated by the EICAS advisory message ENG EEC MODE (L, R) and illumination of the EEC ALTN light on the associated EEC mode switch. Selecting the alternate mode on both engines eliminates thrust lever stagger at equal thrust settings, or asymmetric thrust when the thrust levers are operated together.

The autothrottles remain engaged whenever the EEC automatically switches to the alternate mode. The alternate mode N1 reference/target values are computed by the FMC.

Note: Autothrottles remains engaged in the soft or hard alternate mode.

The alternate mode schedule (N1 schedule) provides equal or greater thrust than the normal mode for the same thrust lever position.

Thrust protection is not provided in the alternate mode and maximum rated thrust is reached at a thrust lever position less than full forward. As a result, thrust overboost can occur at full forward thrust lever positions. The EICAS caution message ENG LIMIT PROT (L, R) is displayed if the thrust lever position commands an N1 greater than the maximum rated thrust (maximum N1). N1 and N2 red line protection is still available in the alternate control mode.

Overspeed Protection

[Option PW, GE Engines]

The EEC also provides N1 and N2 red line overspeed protection. If N1 or N2 approaches overspeed, the EEC commands reduced fuel flow. The EICAS advisory message ENG RPM LIMITED (L or R) is provided when overspeed protection is provided.

[Option RR Engines]

The EEC also provides N1, N2, and N3 red line overspeed protection. If N1, N2, or N3 approaches overspeed, the EEC commands reduced fuel flow. The EICAS advisory message ENG RPM LIMITED (L or R) is provided when overspeed protection is provided.

If the EECs are in alternate mode, advancing the thrust levers full forward provides some overboost and should be considered only during emergency situations when all other available actions have been taken and terrain contact is imminent.

EEC Idle Selection

The EEC selects minimum idle or approach idle automatically. Minimum idle is a lower thrust than approach idle. Approach idle is selected in flight if:

- engine anti-ice is operating
- the flaps are commanded to 25 or greater
- one hydraulic system air-driven demand pump is inoperative, and the flaps are out of the UP position
- the opposite engine bleed air valve is closed

Approach idle decreases acceleration time for go-around. Approach idle is maintained until after touchdown, when minimum idle is selected.

Engine Start and Ignition System

The engines can be started using the autostart system or manually. Autostart is the normal starting mode. Selecting OFF on the AUTOSTART switch disables autostart and allows manual, pilot-monitored, starting.

[PW, GE Engines]

Bleed air powers the starter motor, which is connected to the N2 rotor. The starter air source is normally the APU, but air from ground carts or another running engine can be used.

[RR Engines]

Bleed air powers the starter motor, which is connected to the N3 rotor. The starter air source is normally the APU, but air from ground carts or another running engine can be used.

[Option - PW, GE Engines with CON IGN position]

The START/IGNITION selectors control the starter air valves and provide continuous ignition capability. Ignition and fuel flow are controlled through the FUEL CONTROL switches.

[Option - RR Engines, GE Engines without CON IGN position]

The START selectors control the starter air valves. Ignition and fuel flow are controlled through the FUEL CONTROL switches.

[PW Engines]

The EEC monitors the start to determine the optimum N2 RPM for starter cutout. At that RPM, the EEC commands starter cutout, and the START/IGNITION selector releases to the NORM position.

[GE Engines with CON IGN position]

At approximately idle N2 RPM, the EEC commands starter cutout, and the START/IGNITION selector releases to the NORM position.

[RR Engines]

The EEC monitors the start and commands starter cutout at 50 percent N3 RPM. The START selector releases to the NORM position.

[PW, GE Engines]

A maximum start limit line (red) is displayed on the EGT indication when the FUEL CONTROL switch is moved to CUTOFF or engine N2 RPM is below idle. It remains displayed after the FUEL CONTROL switch is moved to RUN until the engine is stabilized at idle. The EGT indication changes color to red if the EGT start limit is reached during starting.

[RR Engines]

A maximum start limit line (red) is displayed on the EGT indication when the FUEL CONTROL switch is moved to CUTOFF or engine N3 RPM is below idle. It remains displayed after the FUEL CONTROL switch is moved to RUN until the engine is stabilized at idle. The EGT indication changes color to red if the EGT start limit is reached during starting.

Autostart**[PW Engines]**

Autostart allows the EEC to control fuel and ignition. With the AUTOSTART switch ON, the autostart sequence is initiated by rotating the START/IGNITION selector to START and moving the FUEL CONTROL switch to RUN. For in-flight windmill starts the autostart sequence is initiated by moving the FUEL CONTROL switch to RUN.

The START/IGNITION selector opens the starter air valve to begin dry motoring the engine. Moving the FUEL CONTROL switch to RUN opens the spar fuel valve, but not the engine fuel valve. The proper sequencing of fuel and ignition is controlled by the autostart system. With the FUEL CONTROL switch positioned to RUN, the EEC opens engine fuel metering valve and energizes the ignitor(s) at the appropriate N2 RPM.

During autostart, the EEC monitors EGT, N2 RPM, and other engine parameters until the engine reaches idle. During ground start, the autostart system monitors engine parameters and will abort the start for any of the following:

- hot start
- hung start
- no EGT rise
- compressor stall
- starter shaft failure
- no N1 rotation
- insufficient air pressure for starter operation
- start time exceeds the starter duty cycle timer.

Note: The autostart system does not monitor oil pressure and temperature.

If a hot start, hung start, no EGT rise, or compressor stall is detected, and N2 RPM is less than the starter cutout speed, the EEC turns off fuel and ignition and motors the engine for approximately 30 seconds before making a second attempt. The second attempt uses both ignitors. On the ground, if the second attempt fails, the EEC aborts the start. Fuel and ignition are shut off, and the engine is motored for 30 seconds to clear residual fuel. The starter air valve then closes and the START/IGNITION selector releases to the NORM position. The EICAS caution message ENG AUTOSTART (L or R) is displayed.

On the ground, autostart does not attempt a second start if there is no N1 rotation, insufficient air pressure, the starter shaft fails, the start time exceeds the starter duty cycle, or the start is aborted above starter cutout speed and the EICAS caution message ENG AUTOSTART (L or R) is displayed.

Note: For some conditions, the EEC may rapidly cycle fuel off and on in an attempt to clear the condition.

Note: For in-flight starts, the autostart system temporarily discontinues the start if the takeoff EGT limit is exceeded. Autostart takes corrective action if some start problems are detected, but does not abort the start.

Whenever the AUTOSTART switch is selected OFF, the EICAS advisory message ENG AUTOSTART OFF is displayed and the AUTOSTART switch OFF light illuminates.

Autostart

[GE Engines with CON IGN position]

Autostart allows the EEC to control fuel and ignition. With the AUTOSTART switch ON, the autostart sequence is initiated by rotating the START/IGNITION selector to START and moving the FUEL CONTROL switch to RUN. For in-flight windmill starts the autostart sequence is initiated by moving the FUEL CONTROL switch to RUN.

The START/IGNITION selector opens the starter air valve to begin dry motoring the engine. Moving the FUEL CONTROL switch to RUN opens the spar fuel valve, but not the engine fuel valve. The proper sequencing of fuel and ignition is controlled by the autostart system. With the FUEL CONTROL switch positioned to RUN, the EEC opens engine fuel valve and energizes the ignitor(s) at the appropriate N2 RPM.

During autostart, the EEC monitors EGT, N2 RPM, and other engine parameters until the engine reaches idle. During ground start, the autostart system monitors engine parameters and will abort the start for any of the following:

- hot start
- hung start
- no EGT rise
- compressor stall
- starter shaft failure
- no N1 rotation
- insufficient air pressure for starter operation
- start time exceeds the starter duty cycle timer.

Note: The autostart system does not monitor oil pressure and temperature.

If a hot start, hung start, no EGT rise, or compressor stall is detected, and N2 RPM is less than starter cutout speed, the EEC turns off fuel and ignition and motors the engine for 6 or 30 seconds (depending on the detected condition) before making a second attempt. The second attempt uses both ignitors. If the second attempt fails, a third attempt is made by adjusting the starting fuel flow. If N2 RPM is greater than starter cutout speed, the EEC turns off fuel and ignition, closes the starter air valve and allows the engine to spool down below 30 percent N2 RPM. It then reopens the starter air valve and motors the engine before re-introducing fuel and ignition for subsequent attempt(s).

On the ground, if all attempts fail, the EEC aborts the start. Fuel and ignition are shut off and the engine is motored to clear residual fuel. The starter air valve then closes and the START/IGNITION selector releases to the NORM position. The EICAS caution message ENG AUTOSTART (L or R) is displayed.

On the ground, autostart does not attempt a second or third start if there is no N1 rotation, insufficient air pressure, the starter shaft fails, or the start time exceeds the starter duty cycle. The EICAS caution message ENG AUTOSTART (L or R) is displayed.

Note: For in-flight starts, the autostart system temporarily discontinues the start if a preset EGT between the start and takeoff EGT redline limits is reached, or a hung start is detected. Autostart takes corrective action if some start problems are detected, but does not abort the start.

Whenever the AUTOSTART switch is selected OFF, the EICAS advisory message ENG AUTOSTART OFF is displayed and the AUTOSTART switch OFF light illuminates.

Autostart

[RR Engines]

Autostart allows the EEC to control fuel and ignition. With the AUTOSTART switch ON, the autostart sequence is initiated by rotating the START selector to START and moving the FUEL CONTROL switch to RUN. For in-flight windmill starts the autostart sequence is initiated by moving the FUEL CONTROL switch to RUN.

The START selector opens the starter air valve to begin dry motoring the engine. Moving the FUEL CONTROL switch to RUN opens the spar fuel valve, but not the engine fuel valve. The proper sequencing of fuel and ignition is controlled by the autostart system. With the FUEL CONTROL switch positioned to RUN, the EEC opens engine fuel valve and energizes the ignitor(s) above the appropriate N2 and N3 RPM.

During autostart, the EEC monitors EGT, N3 RPM, and other engine parameters until idle N3 RPM is achieved. During ground start, the autostart system monitors engine parameters and will abort the start for any of the following:

- hot start
- hung start
- no EGT rise
- compressor stall
- starter shaft failure
- no N1 rotation
- insufficient air pressure for starter operation
- start time exceeds the starter duty cycle timer.

Note: The autostart system does not monitor oil pressure and temperature.

If a hot start, hung start, no EGT rise, or compressor is detected and N3 RPM is less than starter cutout speed, the EEC turns off fuel and ignition and motors the engine for 20 to 30 seconds (depending on the detected condition). Following motoring and after EGT falls below 100 degrees C, the EEC re-introduces fuel and ignition using both ignitors. If the second attempt fails and N3 RPM is less than starter cutout speed, the EEC turns off fuel and ignition and motors the engine for 30 seconds and until the EGT is below 100 degrees C. The starter air valve then closes and the START selector releases to the NORM position. The EICAS caution message ENG AUTOSTART (L or R) is displayed.

If no N1 rotation, low starter air pressure, starter shaft failed condition is detected, if the starter duty cycle timer expires, or the start is aborted above starter cutout speed, the EEC aborts the autostart sequence without motoring and will not make a second attempt. The starter air valve then closes and the START selector releases to the NORM position. The EICAS caution message ENG AUTOSTART (L or R) is displayed.

Note: For in-flight starts, the autostart system temporarily discontinues the start if the takeoff EGT redline limit is reached, or if a no light-off or a hung start is detected. If one of these conditions is detected, autostart will windmill the engine for 30 seconds before making another attempt. For starter assisted in-flight starts, autostart does not motor the engine with the starter between attempts. Instead, windmill motoring is used and the starter is re-engaged on the following start attempt. Autostart takes corrective action if some start problems are detected, but does not abort the start. During the second or subsequent start attempts autostart re-introduces fuel and ignition when the EGT falls below 200 degrees C.

Whenever the AUTOSTART switch is selected OFF, the EICAS advisory message ENG AUTOSTART OFF is displayed and the AUTOSTART switch OFF light illuminates.

Manual Start

The AUTOSTART switch must be OFF to accomplish a manual start. The start is accomplished in accordance with the Manual Engine Start procedure (refer to Chapter SNP.7). Ignition and fuel are provided as soon as the FUEL CONTROL switch is positioned to RUN. The start must be monitored until the engine stabilizes at idle.

[RR Engines]

For ground starts, the FUEL CONTROL switch should not be moved to RUN until EGT is below 100 degrees C.

In-Flight Start

[PW, GE Engines]

In-flight start envelope information is displayed on the EICAS display when an engine is not running in flight (N2 RPM below idle RPM) or when an engine is shut down in flight and the respective engine fire switch is not pulled. The in-flight start envelope indicates the airspeed range necessary to ensure an in-flight start at the current flight level. If the current flight level is above the maximum start altitude, the maximum start altitude and respective airspeed range are displayed.

Secondary engine indications are displayed automatically when a FUEL CONTROL switch is moved to CUTOFF in flight or if N2 RPM goes below idle RPM while in flight. A crossbleed start indication is displayed next to the N2 indication if airspeed is below that recommended for a windmilling start.

Refer to Engine In-Flight Start, Chapter NNC.7 for the in-flight start procedure.

For in-flight starts, autostart makes continuous start attempts until the engine either starts or the pilot aborts the start attempt by positioning the FUEL CONTROL switch to CUTOFF (and positioning the start switch to NORM if it was a starter assisted attempt).

In-Flight Start

[RR Engines]

In-flight start envelope information is displayed on the EICAS display when an engine is not running in flight (N3 RPM below idle RPM) or when an engine is shut down in flight and the respective engine fire switch is not pulled. The in-flight start envelope indicates the airspeed range necessary to ensure an in-flight start at the current flight level. If the current flight level is above the maximum start altitude, the maximum start altitude and respective airspeed range are displayed.

Secondary engine indications are displayed automatically when a FUEL CONTROL switch is moved to CUTOFF in flight or if N3 RPM goes below idle RPM while in flight. A crossbleed start indication is displayed next to the N3 indication if airspeed is below that recommended for a windmilling start.

Refer to Engine In-Flight Start, Chapter NNC.7 for the in-flight start procedure.

For in-flight starts, autostart makes continuous start attempts until the engine either starts or the pilot aborts the start attempt by positioning the FUEL CONTROL switch to CUTOFF (and positioning the START switch to NORM if it was a starter assisted attempt).

During a windmilling in-flight start, the EEC monitors engine parameters to provide the best fuel schedule to ensure the shortest possible start time.

Engine Ignition

Each engine has two ignitors. The EEC automatically selects the appropriate ignitor(s). The EEC alternates ignitors for successive engine ground starts. Dual ignitors are always used for in-flight starts.

Main AC power is the normal power source for ignition. Standby AC power provides a backup source.

[PW Engines]

By positioning the START/IGNITION selector to CON, continuous ignition is selected. Both ignitors operate continuously when the respective FUEL CONTROL switch is placed to RUN. The ignitors are turned off when the FUEL CONTROL switch is placed to CUTOFF. When the START/IGNITION selector is in the NORM position, continuous ignition is automatically provided whenever:

- the flap lever is out of the UP position, or
- engine anti-ice is on.

[GE Engines with CON IGN position]

By positioning the START/IGNITION selector to CON with the FUEL CONTROL switch in RUN, continuous ignition is selected. In flight, both ignitors operate continuously. On the ground, both ignitors operate continuously if the flaps are set for takeoff and N1 is above 60%. The ignitors are turned off when the FUEL CONTROL switch is placed to CUTOFF.

[GE Engines with CON IGN position]

When the START/IGNITION selector is in the NORM position and a flameout is detected, continuous ignition is automatically provided until the flameout condition is cleared whenever:

- the flap lever is out of the UP position, or
- engine anti-ice is on.

[GE Engines]

Continuous ignition is inhibited on the ground when N1 is 60% or less.

Auto–Relight**[PW Engines]**

An auto–relight capability is provided for flameout protection. Whenever the EEC detects an engine flameout, both ignitors are activated. A flameout is detected when a rapid decrease in N2 occurs, or N2 is less than idle RPM.

[GE Engines]

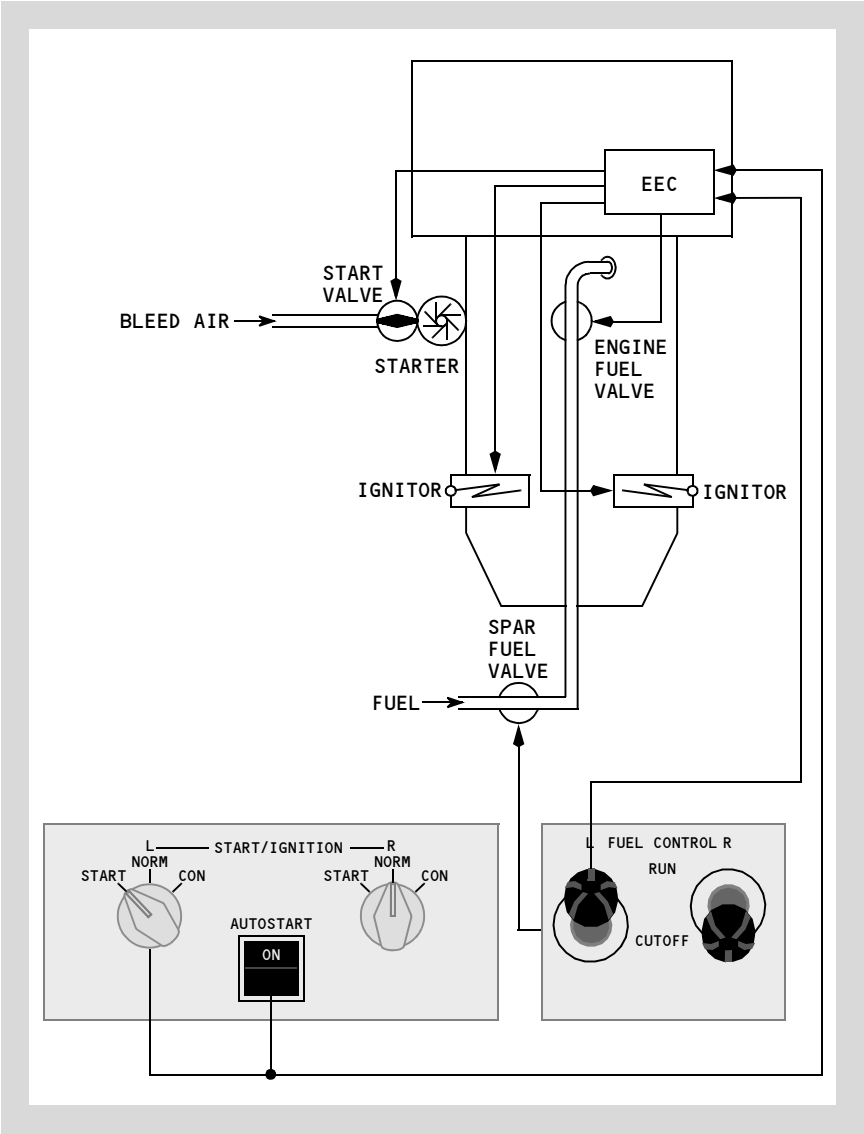
An auto–relight capability is provided for flameout protection and sub–idle stall recovery. If the EEC detects an engine flameout, both ignitors activate. A flameout is detected when a rapid decrease in N2 occurs, or N2 is less than idle RPM. If a sub–idle stall is detected, fuel is shut off for one second in an attempt to clear the stall.

[RR Engines]

There is no manual continuous ignition selection or automatic continuous ignition function. Engine flameout protection is provided for an auto–relight and rain/hail ingestion. The auto–relight function is activated whenever an engine is at or below idle with the FUEL CONTROL switch in RUN. When the EEC detects an engine flameout, the respective engine ignitors are activated. If the engine does not recover and continues to run down below 35% N3, the EEC shuts off fuel and ignition and disables the auto–relight function.

The EEC also provides protection against flameout during periods of excessive rain/hail ingestion. When a flameout is detected, the EEC energizes both ignitors.

Engine Start and Ignition System Schematic



Engine Fuel System

[PW, RR Engines]

Fuel is supplied by fuel pumps located in the fuel tanks. The fuel flows through a spar fuel valve located in the main tank. It then passes through the first stage engine fuel pump where additional pressure is added. It flows through a fuel/oil heat exchanger where it is preheated. A fuel filter removes contaminants. The second stage of the engine fuel pump adds more pressure before the fuel reaches the fuel metering unit. The fuel metering unit adjusts fuel flow to meet thrust requirements. The fuel then flows through the engine fuel valve into the engine.

[GE Engines]

Fuel is supplied by fuel pumps located in the fuel tanks. The fuel flows through a spar fuel valve located in the main tank. It then passes through the first stage engine fuel pump where additional pressure is added. The second stage of the engine fuel pump adds more pressure. It flows through a fuel/oil heat exchanger where it is preheated. A fuel filter removes contaminants. The fuel then reaches the fuel metering unit. The fuel metering unit adjusts fuel flow to meet thrust requirements. The fuel then flows through the engine fuel valve into the engine.

The spar and engine fuel valves allow fuel flow to the engine when both valves are open. The valves open when the engine fire switch is IN and the FUEL CONTROL switch is in RUN. Both valves close when either the FUEL CONTROL switch is in CUTOFF or the engine fire switch is OUT.

Fuel flow is measured after passing through the engine fuel valve. Fuel flow is displayed on the secondary engine display. Fuel flow information is also provided to the FMS.

FUEL SYSTEM

ELECTRICAL

ENGINE FIRE SWITCH

DISCH 1 2

RIGHT

EEC

ENGINE FUEL VALVE

FUEL METERING UNIT

SECOND STAGE

FUEL FILTER

FUEL/OIL HEAT EXCHANGER

FIRST/STAGE

OIL

SPAR FUEL VALVE

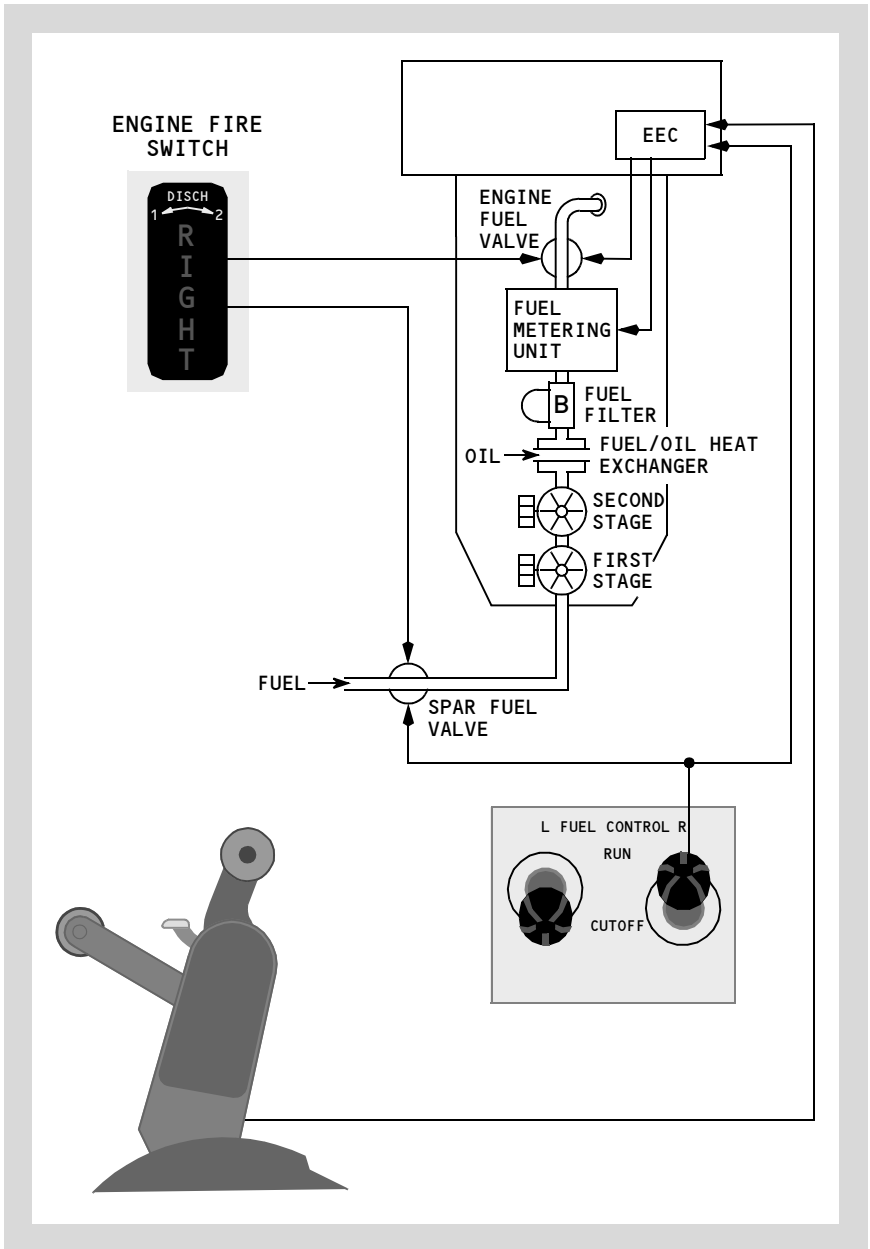
FUEL

L FUEL CONTROL R

RUN

CUTOFF

[GE Engines]



Engine Oil System

The oil system provides pressurized oil to lubricate and cool the engine main bearings, gears and accessory drives. The oil system also provides automatic fuel heating for fuel system icing protection.

[PW Engines]

Oil is pressurized by an engine-driven oil pump. From the pump, the oil flows through a dual oil filter. The oil flows through the air/oil heat exchanger, and fuel/oil heat exchangers and is then delivered to the engine main bearings, gears, and accessory drives. A scavenge pump returns the oil to the reservoir.

[GE Engines]

Oil is pressurized by an engine-driven oil pump. From the pump, the oil flows through the oil filter. If the oil filter becomes clogged, then oil bypasses the oil filter and the EICAS advisory message ENG OIL FILTER (L, R) is displayed. The oil flows through the fuel/oil heat exchangers and then through the backup generator oil/oil heat exchanger, and is then delivered to the engine main bearings, gears, and accessory drives. A scavenge pump returns the oil to the reservoir.

[RR Engines]

Oil is pressurized by an engine-driven oil pump. From the pump, the oil flows through the high pressure oil filter. The oil flows through the air/oil heat exchanger, and fuel/oil heat exchangers and is then delivered to the engine main bearings, gears, and accessory drives. A scavenge pump returns the oil to the reservoir. Prior to the reservoir, the oil flows through a scavenge oil filter. If the scavenge oil filter becomes clogged, then oil bypasses the filter.

[GE Engines]

Oil pressure, temperature, and quantity are displayed on the secondary engine display. Oil pressure and oil temperature are measured prior to entering the engine.

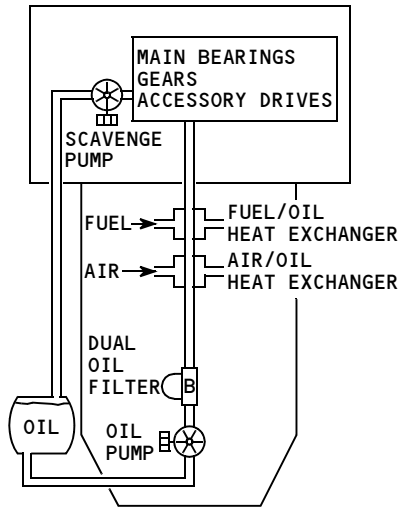
[PW, RR Engines]

Oil pressure, temperature, and quantity are displayed on the secondary engine display. Oil pressure is measured prior to entering the engine. Oil temperature is measured after leaving the engine, prior to entering the reservoir.

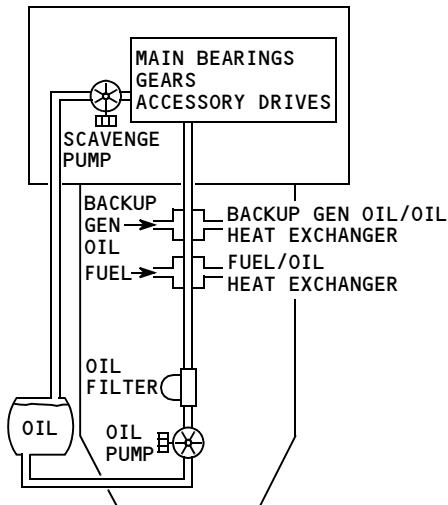
There is no minimum oil quantity limit (no amber or red line limit); however, a low oil quantity causes automatic display of the secondary engine display and reverses the display indication to show black numbers on a white background. There are no operating limitations for the engine oil quantity; therefore, there are no flight crew procedures based solely on a response to low oil quantity.

Engine Oil System Schematic

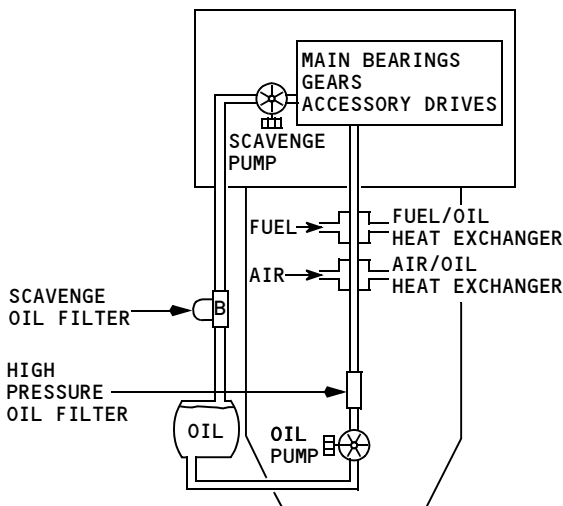
[PW Engines]



[GE Engines]



[RR Engines]



Thrust Reverser System

Each engine has an hydraulically actuated fan air thrust reverser. Reverse thrust is available only on the ground.

The reverse thrust levers can be raised only when the forward thrust levers are in the idle position. When the reverse thrust levers are raised, the EEC opens the reverser isolation valve. The EEC inhibits reverser isolation valve actuation and reverser deployment unless the airplane is on the ground with the engine running. The EECs also control thrust limits during reverser operation.

When the reverse thrust levers are pulled aft to the interlock position:

- the autothrottle disengages
- the auto speedbrakes deploy.

[PW, RR Engines]

When the reverser system is activated:

- the reverser translating sleeves hydraulically move aft
- the fan flow blocker doors rotate into place to direct fan air through stationary cascade guide vanes
- the reverser indication (REV) is displayed above each digital EPR indication (REV is displayed in amber when the reverser is in transit).

[GE Engines]

When the reverser system is activated:

- the reverser translating sleeves hydraulically move aft
- the fan flow blocker doors rotate into place to direct fan air through stationary cascade guide vanes
- the reverser indication (REV) is displayed above each digital N1 indication (REV is displayed in amber when the reverser is in transit).

When the interlock releases:

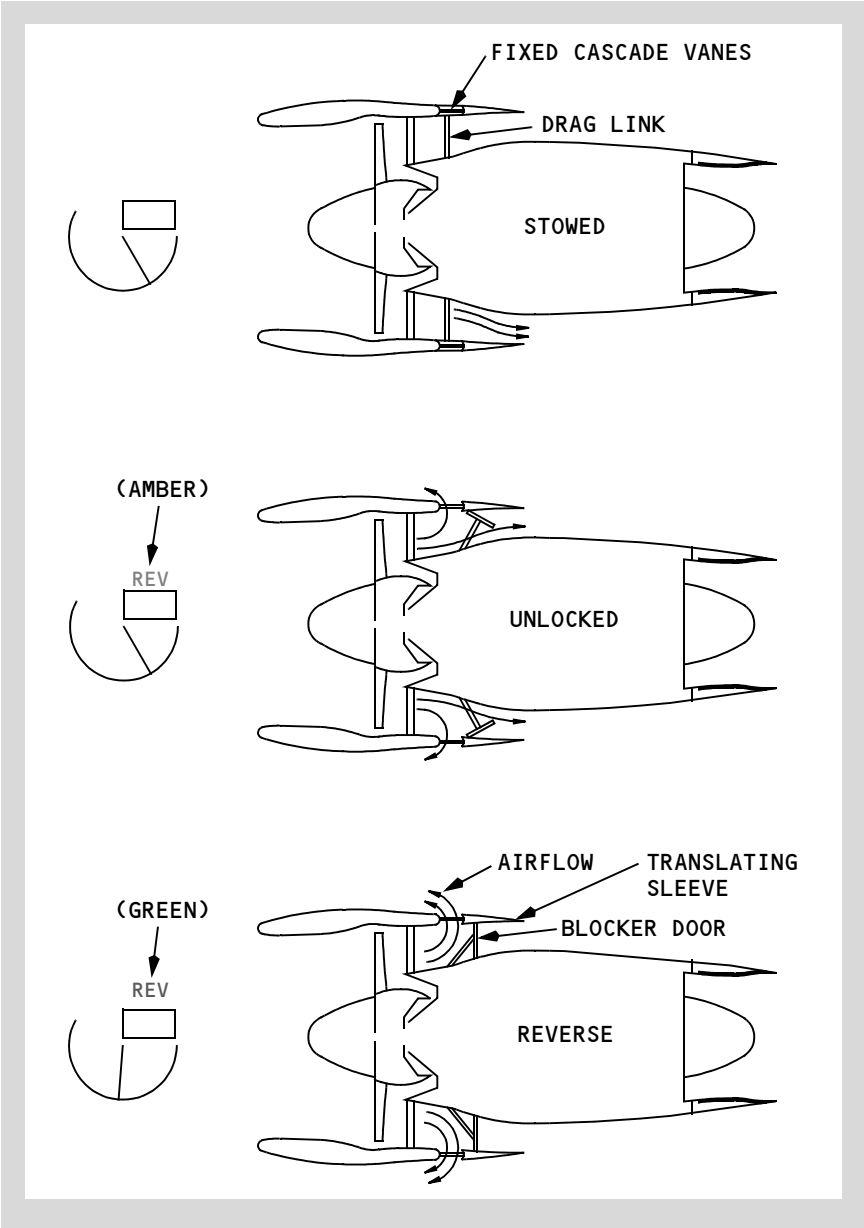
- the reverse thrust levers can be raised to the maximum reverse thrust position
- the REV indication changes to green when the reverser is fully deployed.

Pushing the reverse thrust levers to the full down position retracts the reversers to the stowed and locked position. The thrust levers cannot be moved forward until the reverse thrust levers are fully down.

The EICAS advisory message ENG REV LIMITED (L or R) is displayed if the reverser cannot deploy when commanded, or can deploy only with reverse thrust limited to idle. Not all conditions limiting or preventing reverse thrust can be detected before reverse thrust selection. For these conditions, the reverse thrust levers cannot be moved beyond the interlock position.

The EICAS advisory message ENG REVERSER (L or R) is displayed on the ground to indicate a reverser system fault.

Thrust Reverser Schematic



Airborne Vibration Monitoring System

[PW, GE Engines]

The airborne vibration monitoring system monitors engine vibration levels. The vibration indications are displayed on the secondary engine display. The vibration source indication is also displayed. If the vibration monitoring system cannot determine the source (N1 or N2), broadband (BB) is displayed for the affected engine. Broadband vibration is the average vibration detected.

[PW, GE Engines]

The airborne vibration monitoring system is primarily intended for engine condition monitoring, but it is also a useful tool for isolating and determining corrective action for engine anomalies. There is no certified vibration limit, but when a high vibration level is reached, the secondary engine parameters are automatically displayed. Since there are no operating limitations for the airborne vibration monitoring system, there are no specific flight crew actions (or procedures) based solely on vibration indication. High N1 vibration indication would most likely be accompanied by tactile vibration. This is not the case with high N2 vibration indication. Both N1 and N2 high vibrations may be accompanied by anomalies in other engine parameters and will usually respond to thrust lever adjustment.

[RR Engines]

The airborne vibration monitoring system monitors engine vibration levels. The vibration indications are displayed on the secondary engine display. The vibration source indication is also displayed. If the vibration monitoring system cannot determine the source (N1, N2 or N3), broadband (BB) is displayed for the affected engine. Broadband vibration is the average vibration detected.

[RR Engines]

The airborne vibration monitoring system is primarily intended for engine condition monitoring, but it is also a useful tool for isolating and determining corrective action for engine anomalies. There is no certified vibration limit, but when a high vibration level is reached, the secondary engine parameters are automatically displayed. Since there are no operating limitations for the airborne vibration monitoring system, there are no specific flight crew actions (or procedures) based solely on vibration indication. High N1 vibration indication would most likely be accompanied by tactile vibration. This is not the case with high N2 or N3 vibration indication. N1, N2, and N3 high vibrations may be accompanied by anomalies in other engine parameters and will usually respond to thrust lever adjustment.

[All Engines]

Certain engine malfunctions can result in airframe vibrations from the windmilling engine. As the airplane transitions from cruise to landing, there can be multiple, narrow regions of altitudes and airspeeds where the vibration level can become severe. In general, airframe vibrations can best be reduced by descending and reducing airspeed. However, if after descending and reducing airspeed, the existing vibration level is unacceptable, and if it is impractical to further reduce airspeed, the vibration level may be reduced to a previous, lower level by a slight increase in airspeed.

Engine Failure Alert System

The engine failure alert system provides alerts when actual engine performance is less than commanded engine performance during a part of the takeoff and for other phases of flight.

A red ENG FAIL is displayed on the PFD if actual thrust is less than commanded thrust during takeoff with airspeed between 65 knots and 6 knots prior to V1. The PFD display is accompanied by the voice annunciation ENGINE FAIL and the Master WARNING lights illuminating.

The EICAS caution message ENG FAIL (L or R) is displayed if an engine unexpectedly decelerates to less than idle speed. The message remains displayed until the engine recovers or the fuel control switch is moved to CUTOFF.

The EICAS caution message ENG THRUST (L or R) is displayed if:

- actual thrust is significantly less than commanded thrust
- actual thrust is not increasing to commanded thrust, and
- airspeed is V1 or greater.

Engines, APU
APU System Description**Chapter 7**
Section 30

Introduction

The auxiliary power unit (APU) is a self-contained gas turbine engine located in the airplane tail cone.

The APU can be started and operated to the airplane maximum certified altitude.

The APU supplies bleed air and electrical power. Electrical power has priority over bleed air. Electrical power is available throughout the airplane operating envelope. Bleed air is available at or below 22,000 feet.

Refer to the following chapters for additional information:

- Chapter 2, Air Systems, for a description of APU bleed air operation
- Chapter 6, Electrical, for a description of APU electrical operation
- Chapter 8, Fire Protection, for a description of the APU fire protection system
- Chapter 12, Fuel, for a description of the APU fuel system.

APU Operation**APU Start**

The APU is started either by an electric start motor or an air turbine starter.

The electric starter is powered by the APU battery. The main airplane battery powers the inlet door, fuel valve, and fire detection system.

The air turbine starter uses engine bleed air or ground cart air to start the APU.

Starter selection is automatic. The air turbine starter has priority over the electric start motor when there is sufficient bleed air duct pressure.

Rotating the APU selector to START begins the automatic start sequence.

APU fuel is supplied from the left fuel manifold by any operating AC fuel pump or the DC fuel pump. With AC power available and the APU selector in the ON position, the left forward fuel pump operates automatically.

If AC power is not available or no AC pump pressurizes the left fuel manifold, the DC pump in the left main tank provides APU fuel. On the ground, the APU can be started with no pumps operating.

When the APU air inlet door reaches the full open position the starter engages. After the APU reaches the proper speed, ignition and fuel are provided. When the APU reaches approximately 50 percent, the starter disengages and ignition is turned off.

If the start fails, the APU shuts down automatically. The EICAS message APU SHUTDOWN is displayed.

APU Automatic Start

In flight, if both AC transfer busses lose power, the APU automatically starts, regardless of APU selector position. The APU can be shut down by positioning the selector to ON, then OFF.

APU Run

The EICAS memo message APU RUNNING is displayed when the APU is operating normally.

APU Shutdown

Rotating the APU selector to OFF begins the shutdown cycle by closing the APU bleed air valve. The APU continues running for a cooldown period. The EICAS memo message APU COOLDOWN is displayed during the cooldown period. When the cooldown period finishes, the APU shuts down.

APU Operating Modes

The APU has attended and unattended operating modes. The attended mode operates when either engine is running or starting, or when the airplane is in flight. The unattended mode operates at all other times on the ground.

APU Attended Mode

In the attended mode, any of the following faults cause the APU to shut down immediately:

- APU fire/inlet over temperature
- overspeed/loss of overspeed protection
- APU controller failure
- speed droop.

There is no cool down period. The EICAS advisory message, APU SHUTDOWN, displays.

For the following faults, the APU continues to operate and the EICAS message APU LIMIT displays:

- high EGT
- high oil temperature
- low oil pressure.

There is no cooldown period when the APU is shut down after the APU LIMIT message is displayed.

APU Unattended Mode

In the unattended mode, any of the following faults cause the APU to shutdown immediately:

- APU fire/inlet overtemperature
- overspeed/loss of overspeed protection
- high EGT
- low oil pressure
- high oil temperature
- generator oil filter approaching bypass
- intake door failure
- APU controller failure
- speed droop
- no combustion on start
- no acceleration on start.

There is no cooldown period.

Intentionally
Blank

**Engines, APU
EICAS Messages****Chapter 7
Section 40****Engines, APU EICAS Messages**

The following EICAS messages can be displayed.

APU

Message	Level	Aural	Message Logic
APU COOLDOWN	Memo		APU is in cooldown mode.
APU LIMIT	Caution	Beeper	APU operation has exceeded a limit.
APU RUNNING	Memo		APU running, and not in cooldown mode.
APU SHUTDOWN	Advisory		APU has automatically shut down.

Engine**Control**

Message	Level	Aural	Message Logic

[Option – GE Engines except 115B]

ENG ANTI-ICE AIR L, R	Advisory		Engine anti-ice capability is degraded.
-----------------------	----------	--	---

ENG CONTROL L, R	Advisory		Fault is detected in the affected engine control system.
ENG EEC MODE L, R	Advisory		Control for the affected engine is operating in alternate mode.
ENG FAIL L, R	Caution	Beeper	Engine speed is below idle.
ENG IDLE DISAGREE	Advisory		One engine is at approach idle and the other engine is at minimum idle.
ENG LIMIT PROT L, R	Caution	Beeper	Engine control is operating in the alternate mode and commanded N1 exceeds maximum N1.

Message	Level	Aural	Message Logic
ENG REV LIMITED L, R	Advisory		Engine thrust reverser will not deploy or reverse thrust will be limited to idle on landing.
ENG REVERSER L, R	Advisory		Fault is detected in the affected engine reverser system.

[Option – GE or PW Engines]

ENG RPM LIMITED L, R	Advisory		Engine control is limiting affected engine thrust to prevent N1 or N2 from exceeding the RPM operating limit.
-------------------------	----------	--	---

[Option – RR Engines]

ENG RPM LIMITED L, R	Advisory		Engine control is limiting affected engine thrust to prevent N1, N2, or N3 from exceeding the RPM operating limit.
-------------------------	----------	--	--

ENG SHUTDOWN	Caution		Both engines were shutdown on the ground by the fuel control switches or fire switches.
ENG SHUTDOWN L, R	Caution		Engine was shutdown by the fuel control switch or fire switch.
ENG THRUST L, R	Caution	Beeper	Engine is not producing commanded thrust.

Start

[PW engines and GE engines with CON IGN.]

Message	Level	Aural	Message Logic
ENG AUTOSTART L, R	Caution	Beeper	During a ground start, any of the following conditions occurs: • autostart did not start the engine • fuel control switch is in RUN at low engine RPM with the autostart switch off.
ENG AUTOSTART OFF	Advisory		Engine autostart switch is OFF.
ENG START VALVE L, R	Advisory		Engine start valve is not in commanded position.
ENG STARTER CUTOFF L, R	Caution	Beeper	Start/ignition selector remains in START or engine start valve is open when commanded close.

[RR engines and GE engines with no CON IGN.]

Message	Level	Aural	Message Logic
ENG AUTOSTART L, R	Caution	Beeper	During a ground start, any of the following conditions occurs: • autostart did not start the engine • fuel control switch is in RUN at low engine RPM with the autostart switch off.
ENG AUTOSTART OFF	Advisory		Engine autostart switch is OFF.
ENG START VALVE L, R	Advisory		Engine start valve is not in commanded position.
ENG STARTER CUTOFF L, R	Caution	Beeper	Start selector remains in START or engine start valve is open when commanded close.

Ignition**[Options – GE Engines with CON IGN position, PW Engines]**

Message	Level	Aural	Message Logic
CON IGNITION ON L, L+R, R	Memo		Indicates respective engine START/IGNITION selector CON position selected.

Fuel

Message	Level	Aural	Message Logic
ENG FUEL FILTER L, R	Advisory		An impending fuel filter bypass condition exists on the affected engine.
ENG FUEL VALVE L, R	Advisory		Engine fuel or spar valve position disagrees with commanded position.

Oil

Message	Level	Aural	Message Logic

[Option – GE Engines]

ENG OIL FILTER L, R	Advisory		Affected engine oil filter contamination has caused filter bypass.
------------------------	----------	--	---

[Option – PW, RR Engines (with PW optional ENG OIL FILTER message)]

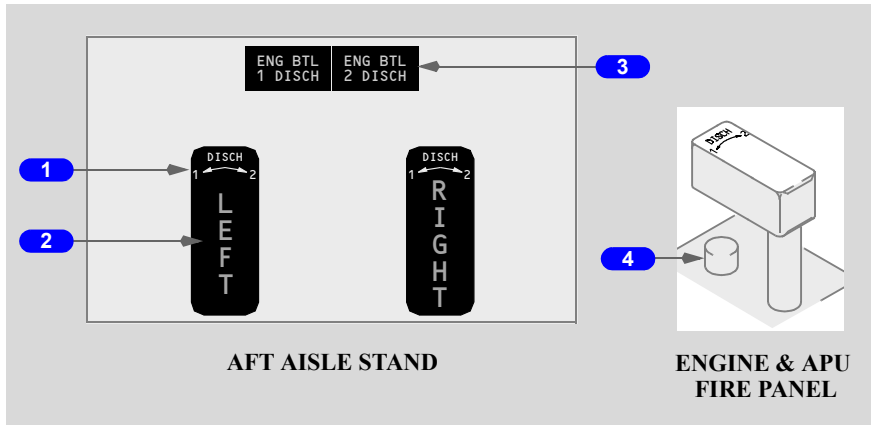
ENG OIL FILTER L, R	Advisory		Primary engine oil filter contamination approaching a bypass condition, oil will be filtered through the secondary filter.
------------------------	----------	--	--

ENG OIL PRESS L, R	Caution	Beeper	Engine oil pressure is low.
ENG OIL TEMP L, R	Advisory		Engine oil temperature is high.

Fire Protection**Chapter 8****Table of Contents****Section 0**

Controls and Indicators	8.10
Engine Fire Protection	8.10.1
Engine Fire Panel	8.10.1
Fuel Control Switches	8.10.2
APU and Cargo Fire Panel	8.10.2
APU Ground Control Fire Protection Panel	8.10.8
System Description	8.20
Introduction	8.20.1
Engine Fire Protection	8.20.1
Engine Fire and Overheat Detection	8.20.2
Engine Fire Extinguishing	8.20.3
APU Fire Protection	8.20.3
APU Fire Detection	8.20.4
APU Fire Extinguishing	8.20.4
Main Wheel Well Fire Protection	8.20.4
Main Wheel Well Fire Detection	8.20.4
Main Wheel Well Fire Warning	8.20.4
Cargo Compartment Fire Protection	8.20.5
Cargo Compartment Smoke Detection	8.20.5
Cargo Compartment Fire Warning	8.20.5
Cargo Compartment Fire Extinguishing	8.20.5
Cargo Compartment Fire Protection	8.20.6
Cargo Compartment Smoke Detection	8.20.6
Cargo Compartment Fire Warning	8.20.6
Lower Cargo Compartment Fire Extinguishing	8.20.6
Main Deck Cargo Compartment Fire Suppression	8.20.7
Crew Rest Compartment Fire Protection	8.20.7
Door 1 Upper Crew Rest Compartment Smoke Detection . . .	8.20.7
Door 3 Upper Crew Rest Compartment Smoke Detection . . .	8.20.7
Door 4 Upper Crew Rest Compartment Smoke Detection . . .	8.20.7

Door 5 Upper Crew Rest Compartment Smoke Detection . . .	8.20.8
Flight Deck Crew Rest Compartment Smoke Detection	8.20.8
Lower Crew Rest Compartment Smoke Detection	8.20.8
Lower Crew Rest Compartment Fire Extinguishing	8.20.8
Equipment Cooling System Fire Protection	8.20.8
Lavatory Fire Protection	8.20.8
Lavatory Fire Detection	8.20.9
Lavatory Fire Extinguishing	8.20.9
Cabin Area Compartment Fire Protection	8.20.9
Cabin Area Compartment Fire Detection	8.20.9
Fire and Overheat Detection System Fault Test	8.20.9
Fire and Overheat Detection System Automatic Fault Test . .	8.20.10
Fire and Overheat Detection System Manual Fault Test . . .	8.20.10
EICAS Messages	8.30
Fire Protection EICAS Messages	8.30.1
Airplane System EICAS Messages	8.30.1
Cabin System EICAS Messages	8.30.3
System Test Messages	8.30.4

**Fire Protection
Controls and Indicators****Chapter 8
Section 10****Engine Fire Protection****Engine Fire Panel****1 Engine Fire Switches**

In (normal position, mechanically locked) – unlocks automatically for a fire warning, or when the FUEL CONTROL switch is in CUTOFF.

Out –

- arms both engine fire extinguishers
- closes the associated engine and spar fuel valves
- closes the associated engine bleed air valves
- trips the associated engine generators off
- shuts off hydraulic fluid to the associated engine–driven hydraulic pump
- depressurizes the associated engine–driven hydraulic pump
- removes power to the thrust reverser isolation valve.

Rotate to position 1 or 2 – discharges the selected fire extinguisher into the engine.

2 Engine Fire Warning Lights

Illuminated (red) –

- an engine fire is detected, or
- the FIRE/OVERHEAT TEST switch is pushed.

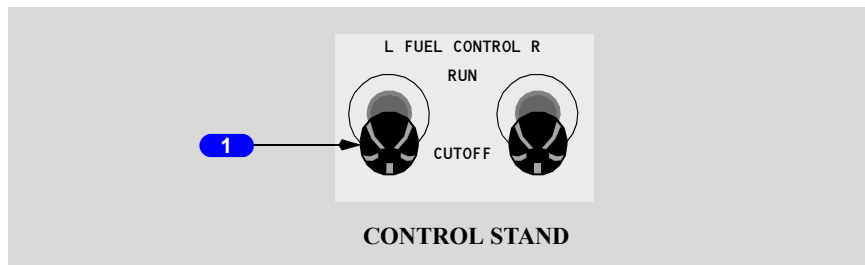
3 Engine Bottle Discharged (ENG BTL DISCH) Lights

Illuminated (amber) – the extinguisher bottle is discharged or has low pressure.

4 Engine and APU Fire Override Switches

Push – unlocks the fire switch.

Fuel Control Switches



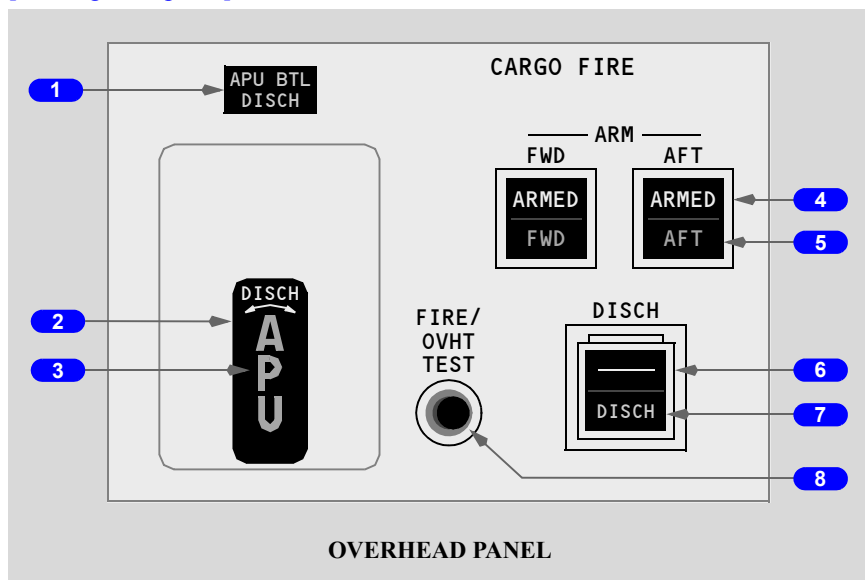
1 FUEL CONTROL Switch Fire Warning Lights

Illuminated (red) –

- an associated engine fire is detected, or
- the FIRE/OVERHEAT TEST switch is pushed.

APU and Cargo Fire Panel

[Passenger Airplane]



1 APU Bottle Discharge (APU BTL DISCH) Light

Illuminated (amber) – the extinguisher bottle is discharged or has low pressure.

2 APU Fire Switch

In – normal position, mechanically locked; unlocks automatically for a fire warning.

Out –

- arms the APU fire extinguisher bottle
- closes the APU fuel valve
- closes the APU bleed air valves
- closes the APU air inlet door
- trips the APU generator field and generator breaker
- shuts down the APU (if automatic shutdown does not occur).

Rotate – either direction discharges the APU fire extinguisher into the APU compartment.

3 APU Fire Warning Light

Illuminated (red) –

- an APU fire is detected, or
- the FIRE/OVERHEAT TEST switch is pushed.

The APU automatically shuts down for a detected fire.

4 CARGO FIRE ARM Switches

ARMED –

- arms all cargo fire extinguisher bottles
- arms the selected compartment extinguisher valve
- turns off both lower recirculation fans
- shuts down cargo heat
- commands the packs to provide the minimum air flow required to provide pressurization
- shuts down the bulk cargo compartment ventilation system operation (aft cargo fire only)
- puts the equipment cooling system into the override mode (forward cargo fire only)
- activates lower crew rest evacuation system (aft cargo fire only)

Off (blank) – normal position.

5 CARGO FIRE Warning Lights

Illuminated (red) – the FIRE/OVERHEAT TEST switch is pushed, or associated cargo compartment smoke is detected and aircraft systems are commanded to shut down –

- AFT or FWD illuminated –
 - both lower recirculation fans
 - lavatory/galley vent fans
 - cargo heat in respective compartment
- FWD illuminated –
 - equipment cooling system in the override mode

6 CARGO FIRE Discharge (DISCH) Switch

Push – discharges the fire extinguisher bottles into the ARMED cargo compartment.

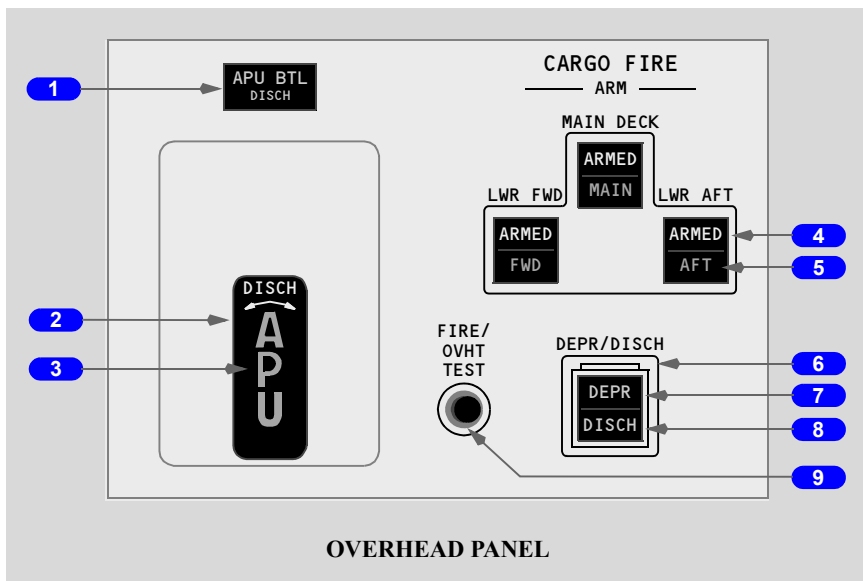
7 CARGO FIRE Discharge (DISCH) Light

Illuminated (amber) – the fire extinguishers have discharged.

8 FIRE/OVERHEAT TEST Switch

Push and hold –

- sends fire/overheat test signals to the engine, APU, wheel well, and cargo compartment fire detector systems
- tests flight deck fire and overheat indications (see Fire and Overheat Detection System Manual Fault Test, Section 20).

[\[Freighter Airplane\]](#)**1 APU Bottle Discharge (APU BTL DISCH) Light**

Illuminated (amber) – the extinguisher bottle is discharged or has low pressure.

2 APU Fire Switch

In – normal position, mechanically locked; unlocks automatically for a fire warning.

Out –

- arms the APU fire extinguisher bottle
- closes the APU fuel valve
- closes the APU bleed air valves
- closes the APU air inlet door
- trips the APU generator field and generator breaker
- shuts down the APU (if automatic shutdown does not occur).

Rotate – either direction discharges the APU fire extinguisher into the APU compartment.

3 APU Fire Warning Light

Illuminated (red) –

- an APU fire is detected, or
- the FIRE/OVERHEAT TEST switch is pushed.

The APU automatically shuts down for a detected fire.

4 CARGO FIRE ARM Switches

- LWR AFT or LWR FWD or MAIN DECK – ARMED –
 - turns off both recirculation fans
 - turns off the lavatory/galley vent fans
 - turns off cargo heat in respective compartment
 - turns off electrical power outlets in respective compartment
 - commands pack to supply air to flight deck and supernumerary areas only
 - turns off the Nitrogen Generation System
- LWR AFT or LWR FWD – ARMED –
 - arms all cargo fire extinguisher bottles
 - arms the selected compartment extinguisher valve
 - puts the equipment cooling system into the override mode
 - turns off cargo air conditioning in respective compartment
- MAIN DECK – ARMED –
 - commands EE cooling to provide pack air to flight deck equipment
 - turns off main deck cargo compartment air in-flow
 - turns off aft cargo air conditioning supply and exhaust

Off (blank) – normal position.

5 CARGO FIRE Warning Lights

Illuminated (red) – the FIRE/OVERHEAT TEST switch is pushed, or associated cargo compartment smoke is detected and aircraft systems are commanded to shut down –

- AFT, or FWD, or MAIN illuminated –
 - both recirculation fans
 - lavatory/galley vent fans
 - cargo heat in respective compartment
- AFT or FWD illuminated –
 - cargo air conditioning in respective compartment
 - equipment cooling system in the override mode
- MAIN illuminated –
 - Main Deck Alerting System activated
 - EE cooling provides pack air to flight deck equipment
 - main deck cargo compartment air in-flow
 - aft cargo air conditioning supply and exhaust

6 CARGO FIRE Depressurization/Discharge (DEPR/DISCH) Switch

Push –

MAIN DECK – ARMED – initiates airplane depressurization to a cabin altitude of 23,000 feet.

LWR AFT or LWR FWD – ARMED – discharges the fire extinguisher bottles into the ARMED cargo compartment.

7 CARGO FIRE Depressurization (DEPR) Light

Illuminated (amber) – airplane depressurization initiated.

8 CARGO FIRE Discharge (DISCH) Light

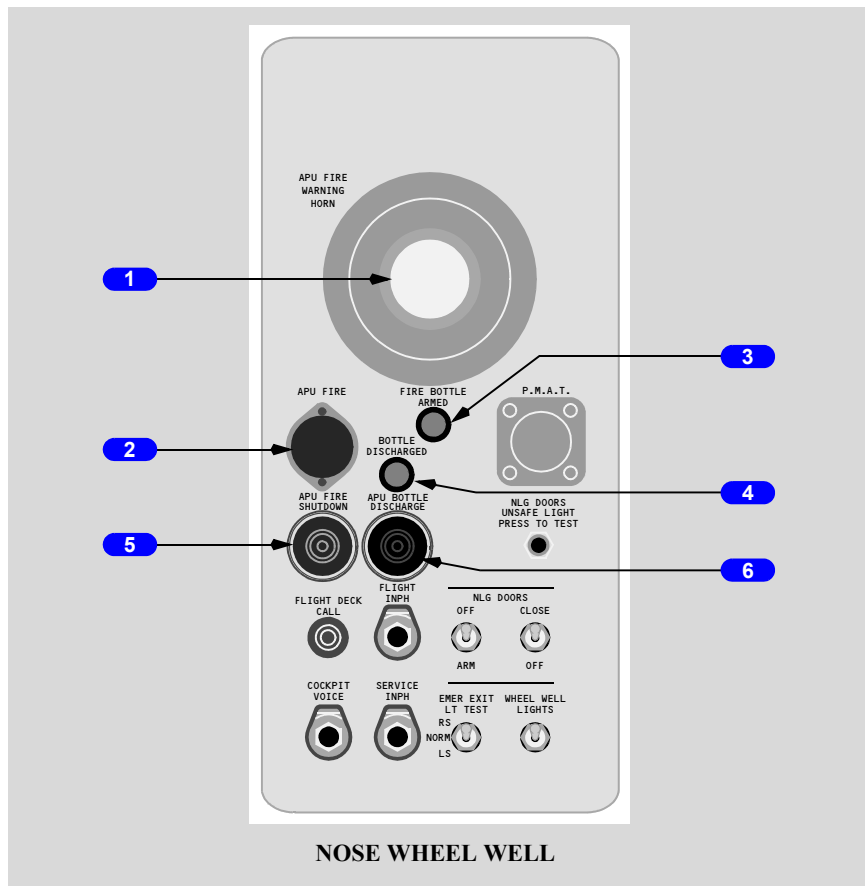
Illuminated (amber) – the fire extinguishers have discharged.

9 FIRE/OVERHEAT TEST Switch

Push and hold –

- sends fire/overheat test signals to the engine, APU, wheel well, and cargo compartment fire detector systems
- tests flight deck fire and overheat indications (see Fire and Overheat Detection System Manual Fault Test, Section 20).

APU Ground Control Fire Protection Panel



1 APU FIRE WARNING HORN

Sounds intermittently during ground operation for an APU fire or fire test.

2 APU FIRE Light

Illuminated (red) –

- an APU fire is detected, or
- a fire/overheat test is in progress.

The APU automatically shuts down for a detected fire.

3 APU FIRE BOTTLE ARMED Light

Illuminated (amber) – the APU fire extinguisher is armed.

4 APU BOTTLE DISCHARGED Light

Illuminated (amber) – the extinguisher bottle pressure is low.

5 APU FIRE SHUTDOWN Switch

Push (red) –

- shuts down the APU
- arms the APU fire extinguisher.

6 APU BOTTLE DISCHARGE Switch

Push – discharges the APU fire extinguisher into the APU compartment.

Intentionally
Blank

**Fire Protection
System Description****Chapter 8
Section 20****Introduction**

There are fire detection and extinguishing systems for the:

- APU
- cargo compartments
- engines
- lavatories.

[\[Option – Crew Rest Compartments\]](#)

The flight deck crew rest compartment has a fire detection system, but no fire extinguishing system.

The lower crew rest compartment has a fire detection system and a manually activated fire extinguishing system.

The door 1 upper crew rest compartment has a fire detection system, but no fire extinguishing system.

The door 2 upper enclosed compartment has a fire detection system, but no fire extinguishing system.

The door 3 upper crew rest compartment has a fire detection system, but no fire extinguishing system.

The door 4 upper crew rest compartment has a fire detection system, but no fire extinguishing system.

The door 5 upper crew rest compartment has a fire detection system, but no fire extinguishing system.

The engines also have overheat detection systems.

The main gear wheel wells have a fire detection system, but no fire extinguishing system.

Refer to the following chapters for additional information:

- Chapter 2 – Air Systems, for descriptions of equipment smoke evacuation, and bleed duct leak and overheat detection.
- Chapter 3 – Anti-Ice, Rain, for a description of engine anti-ice system leak protection.

Engine Fire Protection

Engine fire protection consists of these systems:

- engine fire and overheat detection
- engine fire extinguishing.

Engine Fire and Overheat Detection

There are two detector loops in each engine nacelle. Each detector loop provides both fire and overheat detection. Normally, both loops must detect a fire or overheat condition to cause an engine fire warning or overheat caution.

If a fault is detected in one loop, the system automatically switches to single loop operation. If the operating loop senses a fire or overheat, the system provides the appropriate fire warning or overheat caution.

If there are faults in both detector loops in an engine nacelle, no fire or overheat detection is provided. The EICAS advisory message DET FIRE ENG (L or R) is displayed if the engine fire detection system fails.

Engine Fire Warning

The indications of an engine fire are:

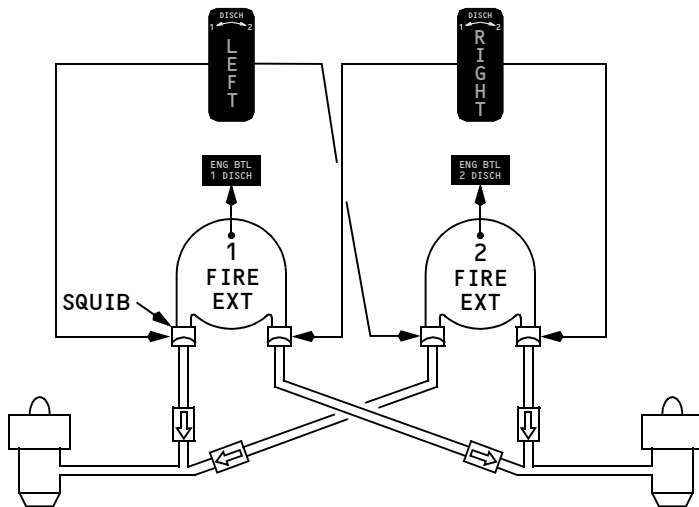
- the fire bell sounds
- the master WARNING lights illuminate
- the EICAS warning message FIRE ENG (L or R) is displayed
- the engine fire switch LEFT or RIGHT fire warning light illuminates
- the engine fire switch unlocks
- the engine FUEL CONTROL (L or R) switch fire warning light illuminates.

Engine Overheat Caution

The indications of an engine overheat are:

- the caution beeper sounds
- the master CAUTION lights illuminate
- the EICAS caution message OVERHEAT ENG (L or R) is displayed.

Engine Fire Extinguishing



ENGINE FIRE EXTINGUISHING DIAGRAM

There are two engine fire extinguisher bottles. Either or both bottles can be discharged into either engine.

When the engine fire switch is pulled out, rotating the fire switch in either direction discharges a single extinguisher bottle into the associated engine. Rotating the engine fire switch in the other direction discharges the remaining extinguisher bottle into the same engine.

If an extinguisher bottle is discharged or has low pressure:

- the ENG BTL (1 or 2) DISCH light illuminates
- the EICAS advisory message BOTTLE (1 or 2) DISCH ENG is displayed.

APU Fire Protection

APU fire protection consists of these systems:

- APU fire detection
- APU fire extinguishing.

APU Fire Detection

The APU compartment has dual fire detector loops. There is no APU overheat detection.

Normally, both loops must detect a fire to produce a fire warning. An APU fire warning automatically shuts down the APU.

If a fault is detected in one loop, the system automatically switches to single loop operation. If the operating loop detects a fire, an APU fire warning occurs and the APU shuts down.

The EICAS advisory message DET FIRE APU is displayed if the APU fire detection system fails.

APU Fire Warning

The indications of an APU fire warning are:

- the fire bell sounds
- the master WARNING lights illuminate
- the EICAS warning message FIRE APU is displayed
- the APU fire switch fire warning light illuminates
- the APU fire switch unlocks.

APU Fire Extinguishing

There is one APU fire extinguisher bottle. When the APU fire switch is pulled out, rotating the switch in either direction discharges the extinguisher bottle into the APU compartment. If the bottle is discharged or has low pressure:

- the APU BTL DISCH light illuminates
- the EICAS advisory message BOTTLE DISCH APU is displayed.

On the ground with both engines off an APU fire signal from either APU fire detector loop causes APU shutdown and extinguisher bottle discharge.

Main Wheel Well Fire Protection

The main wheel well has fire detection only. There is no fire extinguishing system. The nose wheel well does not have a fire detection system.

Main Wheel Well Fire Detection

The main wheel well fire detection system consists of dual fire detector loops.

Main Wheel Well Fire Warning

The indications for a main wheel well fire are:

- the fire bell sounds
- the EICAS warning message FIRE WHEEL WELL is displayed
- the master WARNING lights illuminate.

Cargo Compartment Fire Protection

[Passenger airplane]

Cargo compartment fire protection consists of these systems:

- cargo compartment smoke detection
- cargo compartment fire extinguishing.

Cargo Compartment Smoke Detection

[777-200, 777-200ER, 777-200LR]

The forward and aft cargo compartments each have smoke detectors. Each compartment is divided into three detection zones. If smoke is detected in any zone, a fire warning occurs.

[777-300, 777-300ER]

The forward and aft cargo compartments each have smoke detectors. Each compartment is divided into four detection zones. If smoke is detected in any zone, a fire warning occurs.

Whenever cargo compartment smoke detection is inoperative, the EICAS advisory message DET FIRE CARGO (FWD or AFT) is displayed.

Cargo Compartment Fire Warning

The indications of a cargo compartment fire are:

- the fire bell sounds
- the master WARNING lights illuminate
- the EICAS warning message FIRE CARGO (FWD or AFT) is displayed
- the CARGO FIRE (FWD or AFT) fire warning light illuminates.

Cargo Compartment Fire Extinguishing

Five fire extinguisher bottles are installed for cargo compartment fire extinguishing. Pushing the FWD or AFT CARGO FIRE ARM switch (ARMED visible) arms the extinguishers.

In flight, pushing the CARGO FIRE DISCHARGE switch causes the immediate total discharge of two extinguisher bottles into the selected compartment. After a time delay, the remaining three extinguisher bottles discharge at a reduced flow rate into the selected compartment. If the airplane lands before all of the bottles discharge, one of the remaining bottles discharges at the reduced rate on touchdown.

On the ground, if a CARGO FIRE DISCHARGE switch is pushed, two extinguisher bottles discharge into the selected compartment, but only one of the remaining extinguisher bottles discharges after the time delay.

When cargo fire extinguisher bottle discharge is initiated:

- The CARGO FIRE DISCHARGE switch light illuminates when the first two extinguisher bottles begin to discharge.
- The EICAS advisory message BOTTLE DISCH CARGO is displayed when the first two extinguisher bottles have completely discharged.

[Option - Lower Crew Rest Compartment]

The SMOKE CREW REST LWR message may be displayed during descent following an aft cargo fire. Pressure differences between the aft cargo compartment and the lower crew rest compartment can cause smoke to enter the compartment.

Cargo Compartment Fire Protection

[Freighter]

Cargo compartment fire protection consists of these systems:

- cargo compartment smoke detection
- cargo compartment fire extinguishing or suppression.

Cargo Compartment Smoke Detection

The main deck, forward, and aft cargo compartments each have smoke detectors. Each compartment is divided into multiple detection zones, three for each lower compartment and eight for the main deck. If smoke is detected in any zone, a fire warning occurs.

Whenever cargo compartment smoke detection is inoperative, the EICAS advisory message DET FIRE CARGO (AFT, FWD, or MAIN) is displayed.

Cargo Compartment Fire Warning

The indications of a cargo compartment fire are:

- the fire bell sounds
- the master WARNING lights illuminate
- the EICAS warning message FIRE CARGO AFT, or FIRE CARGO FWD, or FIRE MAIN DECK is displayed
- the CARGO FIRE (AFT, FWD, or MAIN) fire warning light illuminates.

Lower Cargo Compartment Fire Extinguishing

Five fire extinguisher bottles are installed for lower cargo compartment fire extinguishing. Pushing the LWR FWD or LWR AFT CARGO FIRE ARM switch (ARMED visible) arms the extinguishers.

In flight, pushing the CARGO FIRE DEPR/DISCH switch causes the immediate total discharge of two extinguisher bottles into the selected compartment. After a time delay, the remaining three extinguisher bottles discharge at a reduced flow rate into the selected compartment. If the airplane lands before all of the bottles discharge, one of the remaining bottles discharges at the reduced rate on touchdown.

On the ground, if the CARGO FIRE DEPR/DISCH switch is pushed, two extinguisher bottles discharge into the selected compartment, but only one of the remaining extinguisher bottles discharges after the time delay.

When cargo fire extinguisher bottle discharge is initiated:

- The CARGO FIRE DEPR/DISCH switch DISCH light illuminates when the first two extinguisher bottles begin to discharge.
- The EICAS advisory message BOTTLE DISCH CARGO is displayed when the first two extinguisher bottles have completely discharged.

Main Deck Cargo Compartment Fire Suppression

The main deck cargo compartment is a Class E compartment. Pushing the MAIN DECK CARGO FIRE ARM switch configures one pack off and the other to a low flow mode. Subsequently pushing the CARGO DEPR/DISCH switch initiates a controlled depressurization to a cabin altitude of approximately 21,000 feet with the airplane altitude at 23,000 feet.

Crew Rest Compartment Fire Protection

[Option – Flight Deck, Upper, and/or Lower Crew Rest Compartment]

Door 1 Upper Crew Rest Compartment Smoke Detection

Smoke detectors are installed in the door 1 upper crew rest compartment. If smoke is detected, an aural alert sounds in the door 1 crew rest compartment. The EICAS caution message SMOKE REST UPR DR 1 indicates smoke in the compartment.

Door 3 Upper Crew Rest Compartment Smoke Detection

Smoke detectors are installed in the door 3 upper crew rest compartment. If smoke is detected, an aural alert sounds in the door 3 upper crew rest compartment. The EICAS caution message SMOKE REST UPR DR 3 indicates smoke in the compartment.

Door 4 Upper Crew Rest Compartment Smoke Detection

Smoke detectors are installed in the door 4 upper crew rest compartment. If smoke is detected, an aural alert sounds in the door 4 crew rest compartment. The EICAS caution message SMOKE REST UPR DR 4 indicates smoke in the compartment.

Door 5 Upper Crew Rest Compartment Smoke Detection

Smoke detectors are installed in the door 5 upper crew rest compartment. If smoke is detected, an aural alert sounds in the door 5 crew rest compartment. The EICAS caution message SMOKE REST UPR DR 5 indicates smoke in the compartment.

Flight Deck Crew Rest Compartment Smoke Detection

Smoke detectors are installed in the flight deck crew rest compartment. If smoke is detected, an aural alert sounds in the flight deck crew rest compartment. The EICAS caution message SMOKE CREW REST F/D indicates smoke in the flight deck crew rest compartment.

Lower Crew Rest Compartment Smoke Detection

Smoke detectors are installed in the lower crew rest compartment. If smoke is detected, an aural alert sounds in the lower crew rest compartment. The EICAS caution message SMOKE CREW REST LWR indicates smoke in the lower crew rest compartment.

Lower Crew Rest Compartment Fire Extinguishing

The lower crew rest compartment contains a manually activated fire extinguishing system. Portable fire extinguisher bottles augment this system. There is no flight deck indication of fire extinguishing system activation.

Equipment Cooling System Fire Protection

[Freighter]

The equipment cooling system contains a smoke detector, but no fire extinguishing system. When smoke is detected in the equipment cooling system the EICAS caution message SMOKE EQUIP COOLING is displayed.

Refer to Chapter 2, Air Systems, for a description of the equipment cooling system.

Lavatory Fire Protection

Lavatory fire protection consists of these systems:

- lavatory fire detection
- lavatory waste container fire extinguishing.

Lavatory Fire Detection

[Option – SMOKE LAVATORY Message (may also display for other enclosed compartments, such as purser or communications compartments)]

Each lavatory has a single smoke detector. If smoke is detected, an aural alert sounds in the lavatory and in the cabin. In addition, the lavatory call light flashes and the master call light at the associated attendant station illuminates. The EICAS advisory message SMOKE LAVATORY is displayed.

[Option – SMOKE LAV/COMPT Message (may also display for other enclosed compartments, such as purser or communications compartments)]

Each lavatory has a single smoke detector. If smoke is detected, an aural alert sounds in the lavatory and in the cabin. In addition, the lavatory call light flashes and the master call light at the associated attendant station illuminates. The EICAS advisory message SMOKE LAV/COMPT is displayed.

[Freighter]

The lavatory has a single smoke detector. If smoke is detected, an aural alert sounds in the lavatory and in the supernumerary area. The EICAS caution message SMOKE LAVATORY is shown.

Lavatory Fire Extinguishing

[Passenger airplane]

Each lavatory has a fire extinguisher located in the waste container cabinet. Fire extinguisher operation is automatic. There is no flight deck indication.

[Freighter]

The lavatory has a fire extinguisher located in the waste container cabinet. Fire extinguisher operation is automatic. There is no flight deck indication.

Cabin Area Compartment Fire Protection

[Passenger airplane]

Cabin Area Compartment Fire Detection

A smoke detector is installed in the door 2 upper enclosed compartment. If smoke is detected, an aural alert sounds in the cabin. The EICAS caution message SMOKE COMPT UPR DR 2 indicates smoke in the compartment and power is automatically removed from the In-Flight Entertainment system.

Fire and Overheat Detection System Fault Test

The fire and overheat detection system has automatic and manual fault testing.

Fire and Overheat Detection System Automatic Fault Test

Fire and overheat detection system testing is automatic. The engine and APU systems continuously monitor the fire/overheat detector loops for faults. The cargo and wheel well systems continuously monitor for any system faults.

If a fault is detected, the system automatically reconfigures for single loop operation. Complete system failures are indicated by an EICAS advisory message for the failed system:

- DET FIRE ENG (L or R)
- DET FIRE APU
- DET FIRE CARGO (FWD or AFT)

[Freighter]

- DET FIRE CARGO MAIN.

Fire and Overheat Detection System Manual Fault Test

The fire and overheat detection systems can be tested manually by pushing and holding the FIRE/OVERHEAT TEST switch.

The indications for a manual fire and overheat detection system test are:

- the fire bell sounds
- the nose wheel well APU fire warning horn sounds (on the ground)
- the EICAS warning message FIRE TEST IN PROG is displayed
- these lights illuminate:
 - the master WARNING lights
 - the LEFT and RIGHT engine fire warning lights
 - the APU fire warning light
 - the nose wheel well APU fire warning light
 - the LEFT and RIGHT FUEL CONTROL switch fire warning lights
 - the FWD and AFT CARGO FIRE warning lights

[Freighter]

- the MAIN CARGO FIRE warning light.

When the test is complete, the EICAS warning message FIRE TEST PASS or FIRE TEST FAIL replaces the FIRE TEST IN PROG message; the switch can be released. The appropriate system EICAS messages are displayed with the FIRE TEST FAIL message:

- | | |
|-------------------------------|------------------------------|
| • DET FIRE APU | • DET FIRE ENG (L or R) |
| • DET FIRE CARGO (FWD or AFT) | • DET FIRE WHEEL WELL |
| | • DET OVERHEAT ENG (L or R). |

[Freighter]

- DET FIRE CARGO MAIN

All test messages clear when the test switch is released. If the switch is released with the FIRE TEST IN PROG message displayed, the test ends without completing.

Intentionally
Blank

**Fire Protection
EICAS Messages****Chapter 8
Section 30****Fire Protection EICAS Messages**

The following EICAS messages can be displayed.

Airplane System EICAS Messages

Message	Level	Aural	Message Logic
BOTTLE 1, 2 DISCH ENG	Advisory		Engine fire extinguisher bottle 1 or bottle 2 pressure is low.
BOTTLE DISCH APU	Advisory		APU fire extinguisher bottle pressure is low.
BOTTLE DISCH CARGO	Advisory		Both rapid discharge cargo fire extinguisher bottle pressures are low.
DET FIRE APU	Advisory		APU fire detection is inoperative.
DET FIRE CARGO AFT, FWD	Advisory		Affected cargo compartment smoke detection is inoperative.

[Freighter]

DET FIRE CARGO MAIN	Advisory		Affected cargo compartment smoke detection is inoperative.
DET FIRE ENG L, R	Advisory		Affected engine fire detection and overheat are inoperative.
FIRE APU	Warning	Fire Bell	Fire is detected in the APU.
FIRE CARGO AFT, FWD	Warning	Fire Bell	Smoke is detected in the affected cargo compartment.
FIRE ENG L, R	Warning	Fire Bell	Fire is detected in the engine.

[Freighter]

FIRE CARGO MAIN DECK	Warning	Fire Bell	Smoke is detected in the affected cargo compartment.
FIRE WHEEL WELL	Warning	Fire Bell	Fire is detected in a main wheel well.
OVERHEAT ENG L, R	Caution	Beeper	Overheat is detected in the affected nacelle.

[Freighter]

SMOKE EQUIP COOLING	Caution	Beeper	Smoke is detected in the equipment cooling system.
------------------------	---------	--------	---

Cabin System EICAS Messages

[Options – Flight Deck Crew Rest Compartment, Lower Crew Rest Compartment, Lavatory Smoke Detection, Door 1 Upper Crew Rest Compartment, Door 3 Upper Crew Rest Compartment, Door 5 Upper Crew Rest Compartment, Door 2 Overhead Cabin Equipment Center, Connexion by Boeing]

Cabin Area

Message	Level	Aural	Message Logic
SMOKE COMPT UPR DR 2	Caution	Beeper	Smoke is detected in door 2 upper enclosed compartment.

[Passenger airplane]

SMOKE LAVATORY	Advisory		Smoke is detected in one or more lavatories.
-------------------	----------	--	--

[Freighter]

SMOKE LAVATORY	Caution	Beeper	Smoke is detected in the lavatory.
-------------------	---------	--------	------------------------------------

Crew Rest Area

Message	Level	Aural	Message Logic
SMOKE REST UPR DR 1	Caution	Beeper	Smoke is detected in door 1 upper crew rest compartment.
SMOKE REST UPR DR 3	Caution	Beeper	Smoke is detected in door 3 upper crew rest compartment.
SMOKE REST UPR DR 4	Caution	Beeper	Smoke is detected in door 4 upper crew rest compartment.
SMOKE REST UPR DR 5	Caution	Beeper	Smoke is detected in door 5 upper crew rest compartment.

System Test Messages

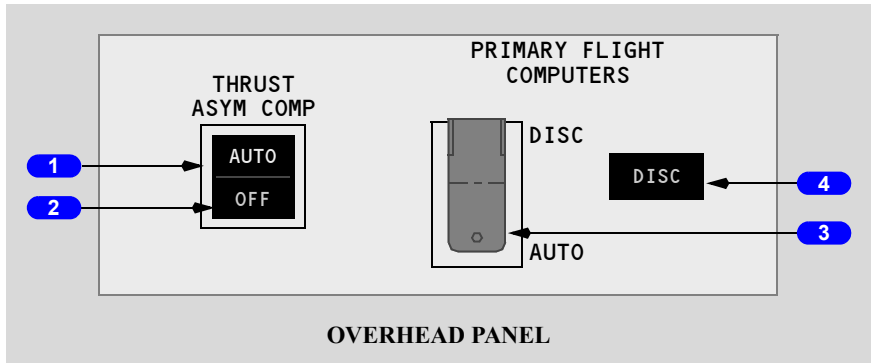
The following messages are associated only with the manually-initiated fire test.

Message	Level	Aural	Message Logic
DET FIRE WHEEL WELL	Advisory		Wheel well fire detection system is failed.
DET OVERHEAT ENG L, R	Advisory		Affected engine overheat detection system is failed.
FIRE TEST FAIL	Warning		One or more fire/overheat detection systems have failed to successfully complete the manually initiated fire/–overheat test.
FIRE TEST IN PROG	Warning		A manually initiated fire/overheat detection system test is in progress.
FIRE TEST PASS	Warning		A manually initiated test of the fire/overheat detection system has been completed.

Flight Controls**Chapter 9****Table of Contents****Section 0**

Controls and Indicators	9.10
Thrust Asymmetry Compensation and Primary Flight Computers Controls	9.10.1
Pitch and Stabilizer Trim Systems	9.10.2
Control Wheel and Column	9.10.2
Stabilizer Trim System	9.10.3
Aileron and Rudder Trim Controls	9.10.4
Rudder/Brake Pedals	9.10.6
Speedbrake Lever	9.10.7
Flap System	9.10.8
Flap Controls	9.10.8
Flap Limit Placard	9.10.9
Normal Flap Position Indication	9.10.10
Flap Load Relief Indication	9.10.11
Expanded Flap and Slat Position Indication	9.10.12
Flight Control Synoptic Displays	9.10.13
Normal Flight Control Synoptic	9.10.14
Non-Normal Flight Control Synoptic	9.10.16
System Description	9.20
Introduction	9.20.1
Pilot Controls	9.20.1
Flight Control Surfaces	9.20.2
Flight Control Surface Locations	9.20.3
Actuator Control Electronics/Hydraulic Power Distribution	9.20.4
Primary Flight Control System Modes	9.20.5
Flight Control System Normal Mode	9.20.5
Flight Control System Secondary Mode	9.20.7
Flight Control System Direct Mode	9.20.8
Normal Mode Pitch Control	9.20.9
Primary Pitch Trim Control	9.20.9

Alternate Pitch Trim	9.20.10
Pitch Envelope Protection	9.20.10
Elevator Variable Feel	9.20.11
Tail Strike Protection	9.20.11
Secondary and Direct Mode Pitch Control	9.20.11
Stabilizer Hydraulic Power and Non-Normal Operation	9.20.12
Stabilizer Shutdown	9.20.12
Stabilizer Position Indication and Greenband	9.20.13
Normal Mode Roll Control	9.20.13
Aileron Trim	9.20.13
Roll Envelope Bank Angle Protection	9.20.14
Secondary and Direct Mode Roll Control	9.20.14
Normal Mode Yaw Control	9.20.14
Thrust Asymmetry Compensation	9.20.15
Wheel to Rudder Cross-Tie	9.20.15
Yaw Damping	9.20.15
Gust Suppression	9.20.16
Rudder Trim	9.20.16
Secondary and Direct Mode Yaw Control	9.20.16
Spoilers	9.20.16
Spoiler Speedbrake Operation	9.20.17
Flaps and Slats	9.20.17
Flap and Slat Sequencing	9.20.18
Flap and Slat Modes	9.20.19
Flap/Slat Load Relief	9.20.20
Autoslats	9.20.21
Flap and Slat Asymmetry Detection	9.20.21
Uncommanded Flap or Slat Motion	9.20.22
Flap Indications	9.20.22
EICAS Messages	9.30
Flight Control System EICAS Messages	9.30.1

Flight Controls
Controls and Indicators**Chapter 9**
Section 10**Thrust Asymmetry Compensation and Primary Flight Computers Controls****1 Thrust Asymmetry Compensation (THRUST ASYM COMP) Switch**

AUTO – the thrust asymmetry compensation system operates automatically if a thrust asymmetry condition is detected.

OFF – disconnects the thrust asymmetry compensation system from the flight control system.

2 Thrust Asymmetry Compensation OFF Light

Illuminated (amber) – the thrust asymmetry compensation system has been automatically or manually disconnected.

3 PRIMARY FLIGHT COMPUTERS Disconnect Switch

DISC –

- disconnects the primary flight computers (PFCs) from the flight control system
- puts the flight control system in the direct mode
- AUTO can be reselected to attempt restoration of secondary or normal mode operation.

AUTO –

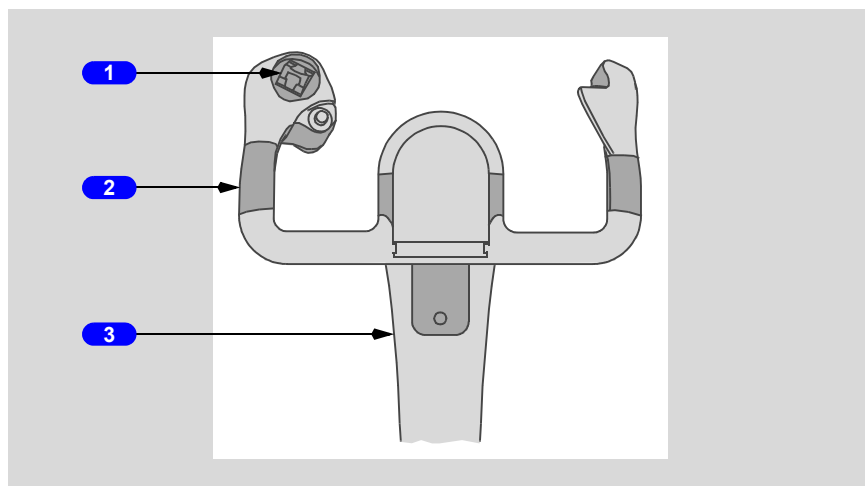
- the flight control system operates in the normal mode
- system faults automatically cause the system to switch to the secondary or direct modes.

4 PRIMARY FLIGHT COMPUTERS Disconnect (DISC) Light

Illuminated (amber) – the primary flight computers are disconnected automatically or manually and the system is in the direct mode.

Pitch and Stabilizer Trim Systems

Control Wheel and Column



1 Pitch Trim Switches

Spring-loaded to neutral.

Push (both switches) –

- in the normal mode in flight, changes the trim reference airspeed
- in the normal mode on the ground, moves the stabilizer
- in the secondary and direct modes, moves the stabilizer.

2 Control Wheel

Rotate – deflects the ailerons, flaperons, and spoilers in the desired direction.

Moves and remains displaced with aileron trim.

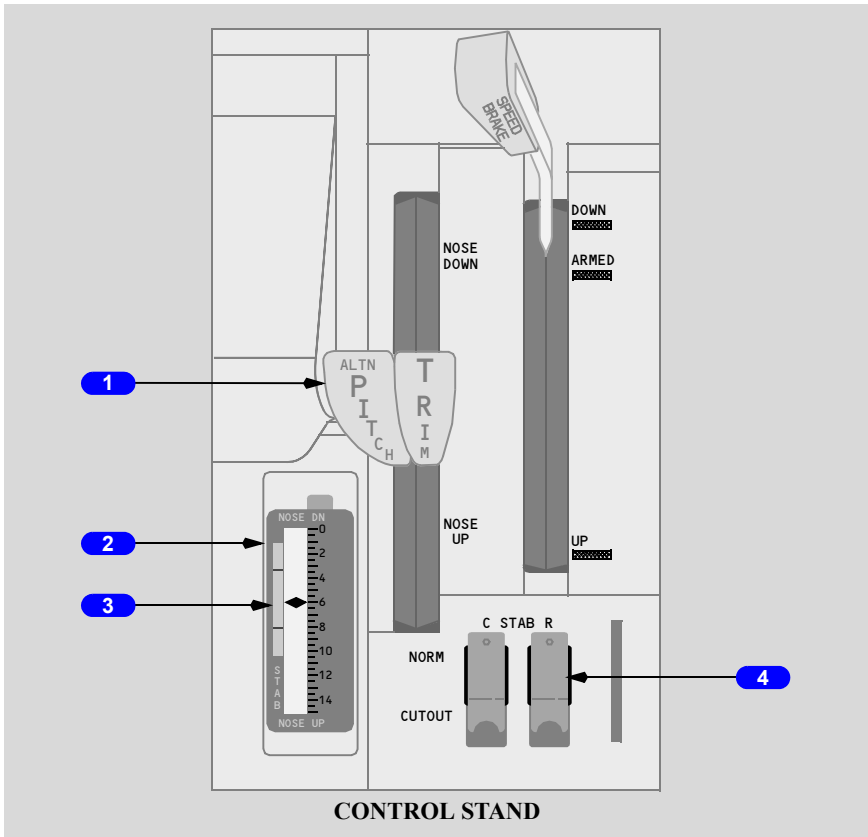
3 Control Column

Push/pull – commands the airplane to pitch in the desired direction:

- in the normal mode, deflects the elevator and horizontal stabilizer
- in the secondary and direct modes, deflects the elevator.

Does not move with pitch trim operation.

Stabilizer Trim System



1 Alternate (ALTN) PITCH TRIM Levers

Spring-loaded to neutral.

Push/pull (both levers) –

- in the normal mode, changes trim reference airspeed and moves the stabilizer directly
- in the secondary and direct modes, moves the stabilizer directly.

2 Stabilizer (STAB) Position Indicator

Indicates stabilizer position in units of trim.

3 Takeoff Trim Green Band

The green band indicates the allowable takeoff trim range, based on gross weight, takeoff thrust, and CG information from the FMC. When no information is available, the green band defaults to midrange.

If the stabilizer signal is not present or is invalid, the green band and the pointer are not displayed.

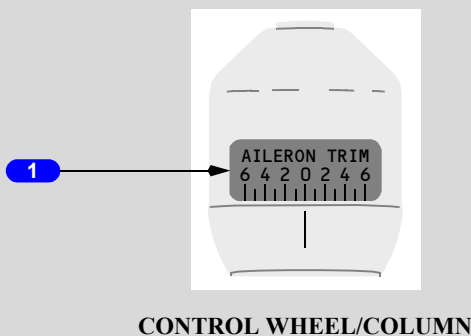
4 Stabilizer (STAB) Cutout Switches

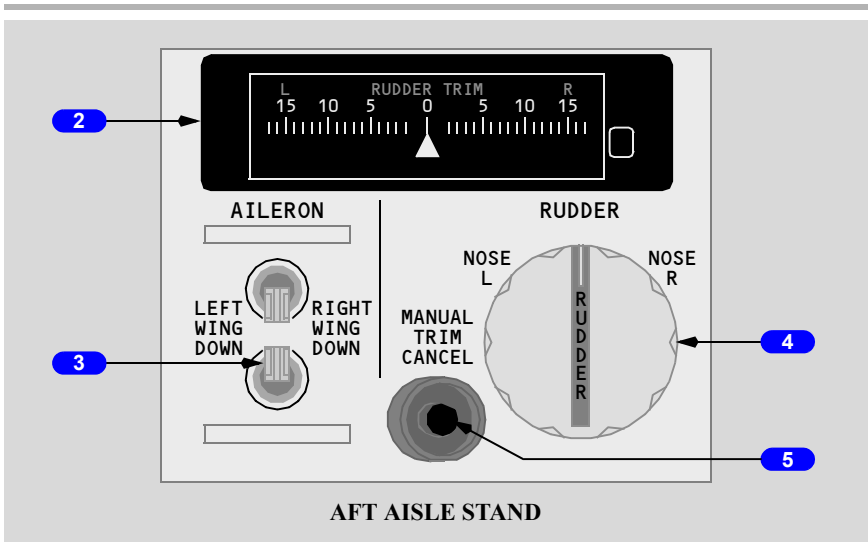
NORM –

- hydraulic power is supplied to the related stabilizer trim control module
- if unscheduled stabilizer motion is detected, center and/or right system hydraulic power to the related stabilizer trim control module is automatically shut off.

CUTOUT – shuts off the respective center or right hydraulic system power to the related stabilizer trim control module.

Aileron and Rudder Trim Controls



**1 AILERON TRIM Indicator**

Indicates units of aileron trim.

2 RUDDER TRIM Indicator

Indicates units of rudder trim.

3 AILERON Trim Switches

Push (both switches) – moves the control wheel, ailerons, flaperons, and spoilers in the desired direction (spring-loaded to neutral).

4 RUDDER Trim Selector

Spring-loaded to neutral.

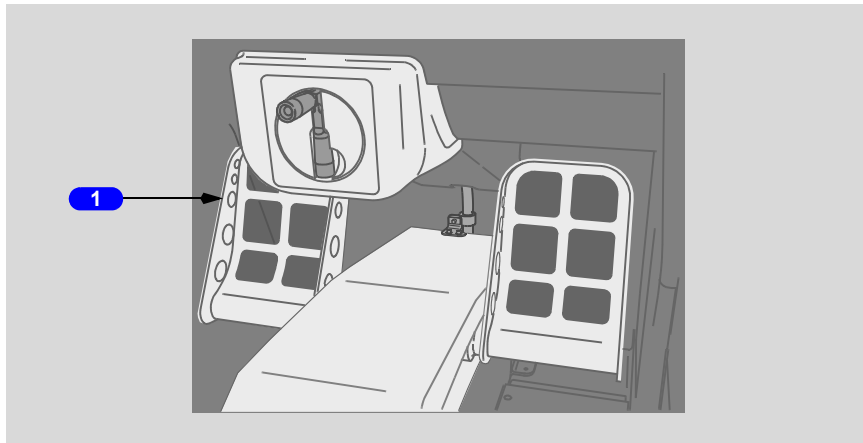
Rotate –

- trims the rudder in the desired direction
- the trim runs at high speed with the knob rotated past the first left or right detent
- the rudder pedals move with rudder trim operation.

5 MANUAL TRIM CANCEL Switch

Push – cancels manual rudder trim in the normal and secondary flight control system modes.

Rudder/Brake Pedals



1 Rudder Pedals

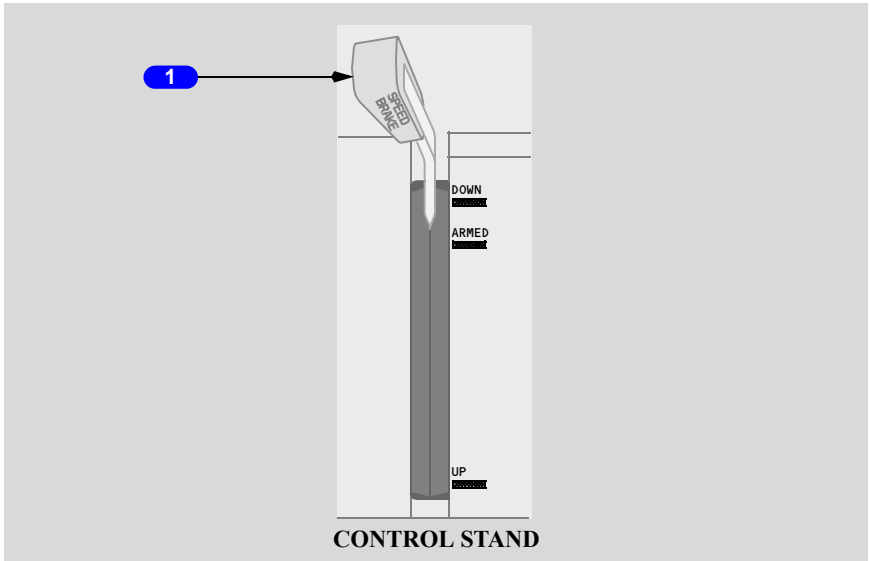
Push – deflects the rudder in the desired direction.

Refer to Chapter 14, Landing Gear, for brakes and nosewheel steering description.

Speedbrake Lever

On the ground:

- the speedbrake lever moves to DOWN and all spoiler panels retract if either thrust lever is advanced to the takeoff thrust position
- the speedbrake lever moves to UP and all spoiler panels extend if either reverse thrust lever is raised to the reverse idle detent.



1 Speedbrake Lever

DOWN (detent) – all spoiler panels are retracted.

ARMED –

- the auto speedbrake system is armed
- after landing, the speedbrake lever automatically moves to UP and the spoiler panels extend.

UP – the required spoiler panels extend to their maximum in-flight or on-ground position (intermediate positions can be selected).

Flap Controls



Secondary mode – positions the slats and/or flaps electrically if hydraulic operation fails.

2 Flap Gates

20 – prevents inadvertent retraction of the flaps past the go-around position.

3 Alternate Flaps Arm (ALTN FLAPS ARM) Switch

- arms the alternate flap control mode
- arms the alternate flaps selector
- disables primary and secondary flap/slat mode operation

777 Flight Crew Operations Manual

- asymmetry/skew and uncommanded motion protection, autoslat, and flap/slat load relief are not available
- the flap lever is inoperative.

4 Alternate Flaps Selector

RET – the slats and flaps are electrically retracted.

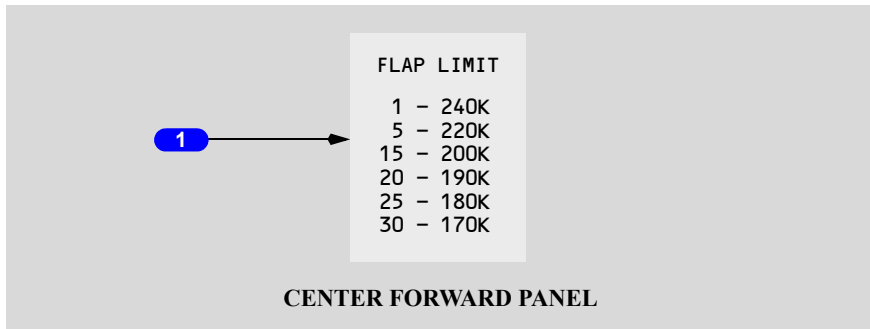
OFF – alternate flaps are deactivated.

EXT –

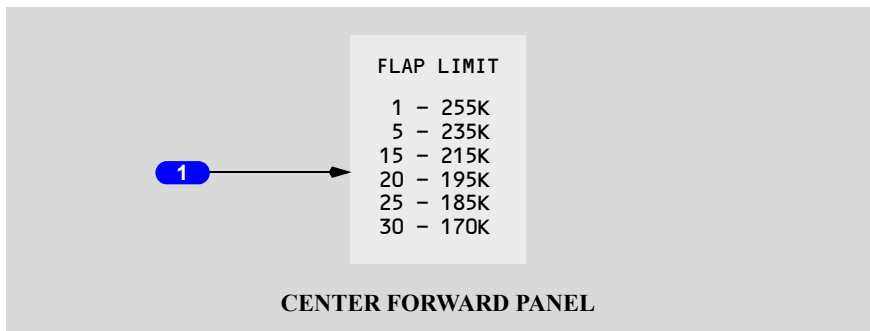
- the slats and flaps are electrically extended
- maximum extension is flaps 20, with the slats at the midrange position.

Flap Limit Placard

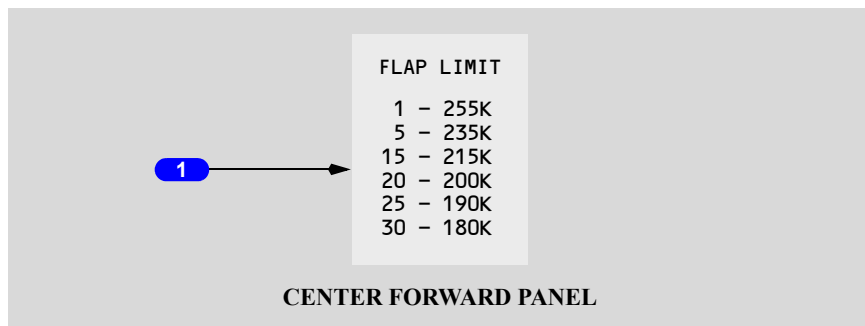
[777-200]



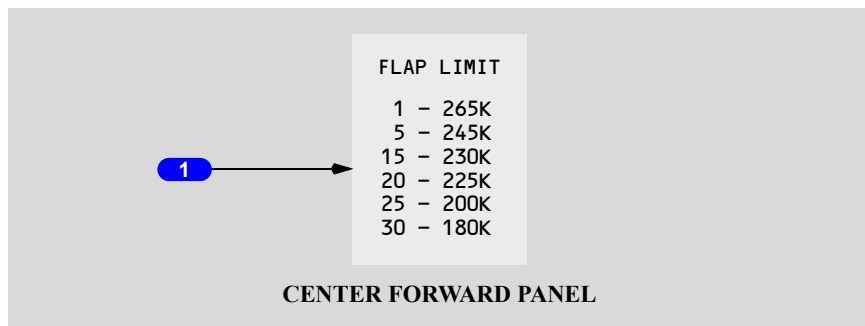
[777-200ER]



[777-300]



[777-200LR, 777F, and 777-300ER]



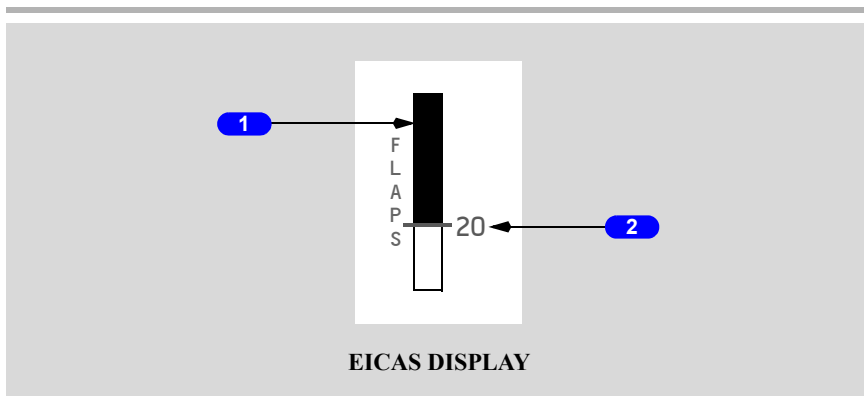
1 Flap Limit Placard

Flaps extended speed limits.

Normal Flap Position Indication

Displays combined flap and slat positions when all surfaces are operating normally and control is in the primary (hydraulic) mode. The indicator shows continuous motion.

The indication is no longer displayed 10 seconds after slat retraction.

**1 Flap Position (white)**

UP – the slats and flaps are retracted.

1 – the slats extend to the midrange position.

5, 15, and 20 –

- the slats remain in the midrange position
- the flaps extend to the commanded position.

25 – the slats extend to the fully extended position. The flaps extend to 25.

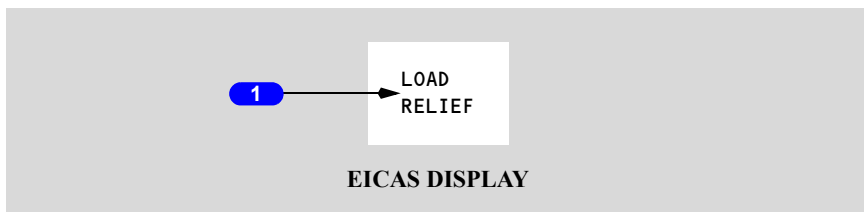
30 – the flaps extend to 30.

2 Flap Lever Position (line and number)

Magenta – the slats or flaps are in transit to the commanded position.

Green – the slats and flaps are in the commanded position.

The line and number change color.

Flap Load Relief Indication

1 Flap LOAD RELIEF Indication

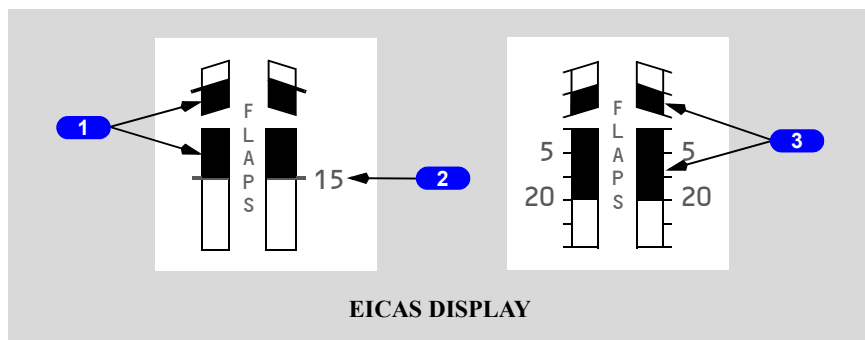
Displayed (white) –

- flap load relief is retracting the flaps, or inhibiting extension, as required to prevent air load damage due to excessive airspeed
- extension from UP is being inhibited due to either excessive airspeed or altitude.

Expanded Flap and Slat Position Indication

If any flap/slat is non-normal or if control is in the secondary mode, slat and flap positions are shown independently. Each wing is also shown separately.

Indicator motion is continuous between flap detents.



1 Expanded Flap and Slat Position Indications

The slat indication fills up (forward) for extension.

The flap indication fills down (aft) for extension.

Indication colors of outline and fill are:

- white when operating in secondary mode
- amber when the respective FLAPS DRIVE or SLATS DRIVE EICAS message is displayed.

Loss of position information is shown as a white outline with no fill and no flap lever position indication.

2 Flap Lever Position (line and number)

Magenta – the slats or flaps are in transit to the commanded position.

Green – the slats or flaps are in the commanded position.

The numbers are shown next to the flap position indicator only.

3 Alternate Flap and Slat Position Indications (white)

Slat and flap extension is limited to slats midrange and flaps 20.

Displayed automatically when the alternate control mode is armed.

Slats – displays the position of the slats.

Flaps – displays the position of the flaps.

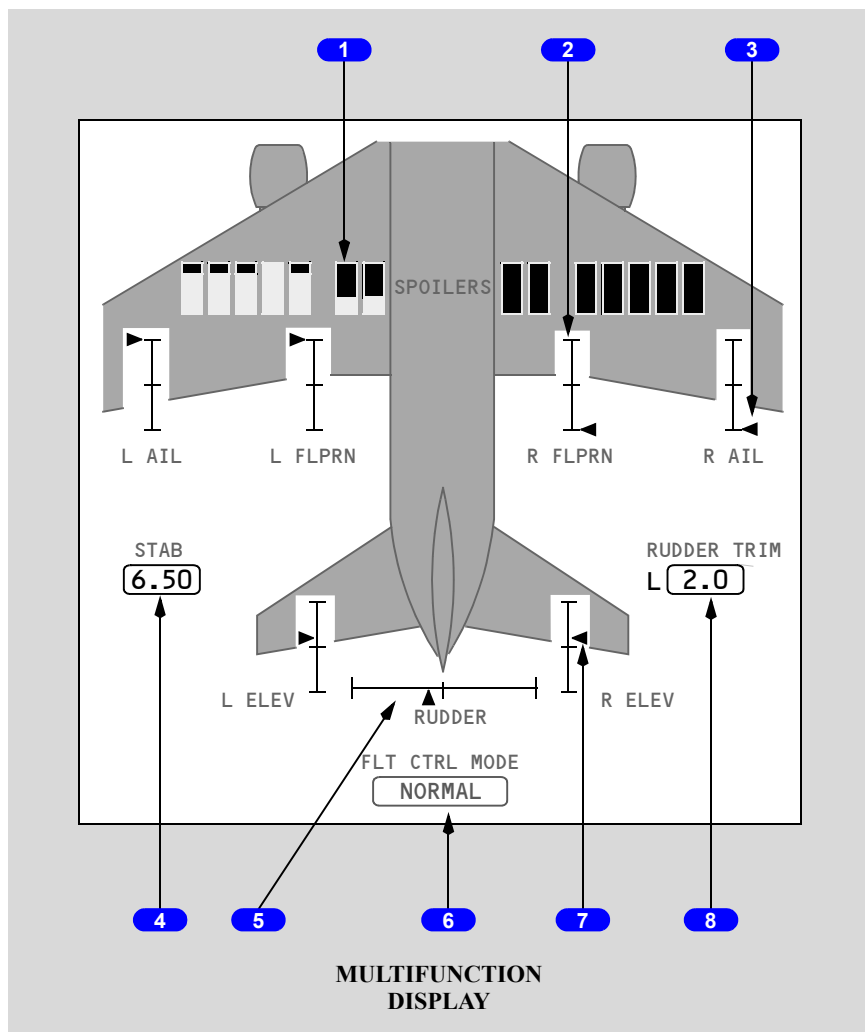
Flap position index marks – reference flaps 5 and 20.

Loss of position information is indicated as a white outline with no fill and no position index marks or numbers.

Flight Control Synoptic Displays

The flight control synoptic is displayed by pushing the FCTL synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

Normal Flight Control Synoptic

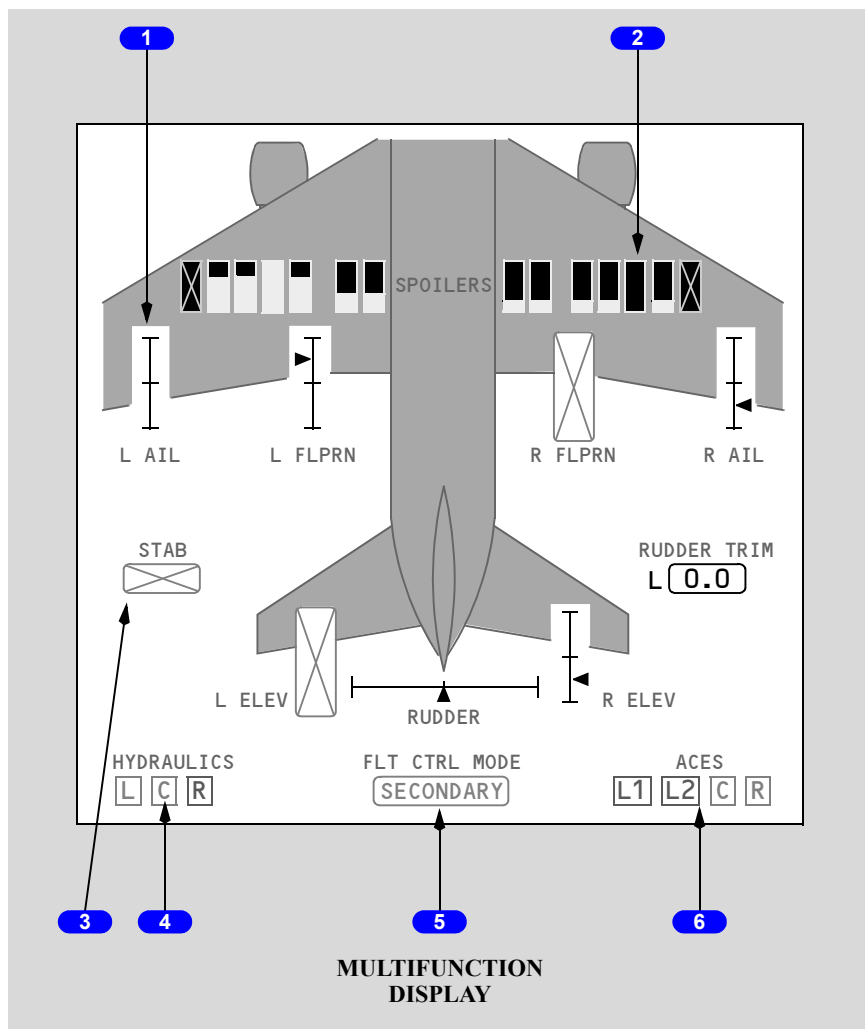


- 1 Spoiler Position**
- 2 Flaperon Position**
- 3 Aileron Position**
- 4 Stabilizer Position**
- 5 Rudder Position**
- 6 Primary Flight Control System Mode**
- 7 Elevator Position**
- 8 Rudder Trim Position and Direction**

L – Left

R – Right

Non-Normal Flight Control Synoptic



1 Unknown Aileron Position

2 Unknown Spoiler Condition

3 Failed Control Surface or Trim Function (amber)

4 Hydraulic System Failure Indications

Green – the hydraulic system is functioning normally.

Amber – the failed hydraulic system.

5 Flight Control Mode SECONDARY or DIRECT Indication (amber)

6 Actuator Control Electronic Failure Indications

Green – the ACE is functioning normally.

Amber – the failed ACE.

Intentionally
Blank

Flight Controls
System Description**Chapter 9**
Section 20**Introduction**

The primary flight control system uses conventional control wheel, column, and pedal inputs from the pilot to electronically command the flight control surfaces. The system provides conventional control feel and pitch responses to speed and trim changes. The system electronic components provide enhanced handling qualities and reduce pilot workload.

The primary flight control system is highly redundant, with three operating modes: normal mode, secondary mode, and direct mode. The primary flight controls are powered by redundant hydraulic sources. The secondary flight controls, high lift devices consisting of flaps and slats, are hydraulically powered with an electrically powered backup system.

Pilot Controls

The pilot controls consist of:

- two control columns
- two control wheels
- two pairs of rudder pedals
- control wheel pitch trim switches
- alternate pitch trim levers
- the speedbrake lever
- the flap lever
- aileron trim switches
- rudder trim selector
- manual rudder trim cancel switch.

The columns and wheels are connected through jam override mechanisms. If a jam occurs in a column or wheel, the pilots can maintain control by applying force to the other column or wheel to overcome the jam.

The rudder pedals are rigidly connected between the two sides.

The speedbrake lever allows manual or automatic symmetric actuation of the spoilers.

The pilot controls command these system electronic components:

- four actuator control electronics (ACEs)
- three primary flight computers (PFCs).

The ACEs receive input signals from all pilot controls. The ACEs send control signals to the primary flight control surfaces. Each ACE is assigned to different actuators on the control surfaces. No single ACE controls more than one actuator on a control surface. Some ACEs are not assigned to all control surfaces.

The EICAS caution message FLIGHT CONTROLS is displayed if:

- multiple ACE and/or hydraulic system failures cause the loss of a significant number of control surfaces, or
- other flight control system faults are detected.

The ACEs can transmit pilot control inputs directly to the control surfaces, or they can send the pilot inputs to the PFCs. When the ACEs are sending pilot inputs to the PFCs, the ACEs receive control commands back from the PFCs and use the commands to position the flight control surfaces.

The PFCs use information from other airplane systems (such as air data, inertial data, flap and slat position, engine thrust, and radio altitude) to compute control surface commands for enhanced handling qualities. See Primary Flight Control System Modes in this Section for a description of these handling quality enhancements.

The autopilot also sends commands to the PFCs, which then produce control surface commands. See Chapter 4, Automatic Flight.

Flight Control Surfaces

Pitch control is provided by:

- two elevators
- a movable horizontal stabilizer.

Roll control is provided by:

- two flaperons
- two ailerons
- fourteen spoilers.

Yaw control is provided by:

- single rudder
- partial span tab.

The two elevators and horizontal stabilizer work together to provide pitch control. A detailed description of pitch control is given in a separate section later in this chapter.

The flaperons and ailerons provide roll control, assisted by asymmetric spoilers.

The flaperons are located between the inboard and outboard flaps on both wings. In the normal mode, they are used for roll control with the flaps either retracted or extended. For increased lift, the flaperons move down and aft in proportion to trailing edge flap extension.

The ailerons are located outboard of the outboard flaps on each wing. For increased lift, the ailerons move down for flaps 5, 15, and 20, to improve takeoff performance.

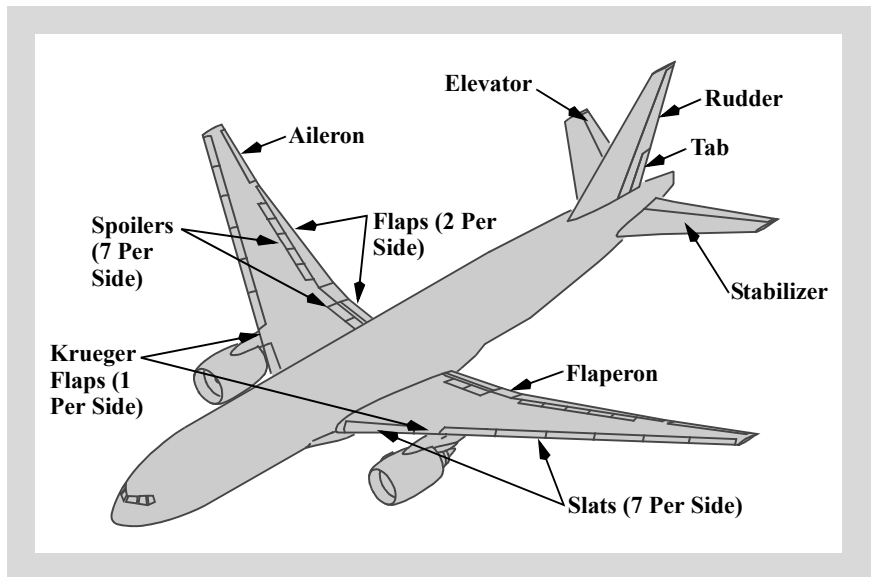
777 Flight Crew Operations Manual

In the normal mode, the ailerons and spoilers 5 and 10 are locked out during high-speed flight; the flaperons and remaining spoilers provide sufficient roll control. During low speed flight, these panels augment roll control.

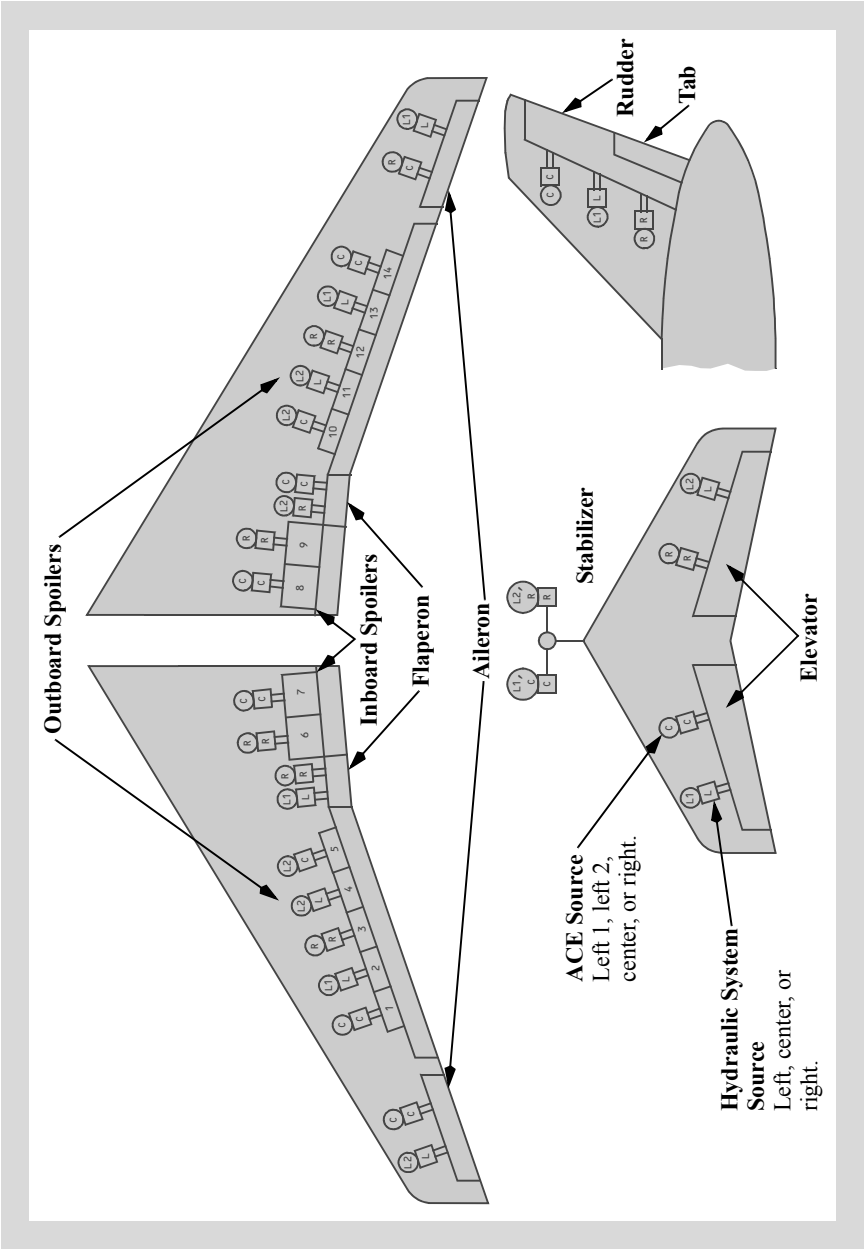
Yaw control is provided by a single rudder, which is almost the same height as the vertical tail. The lower portion of the rudder has a hinged section (tab) that deflects twice as far as the main rudder surface to provide additional yaw control authority. During takeoff, the rudder becomes aerodynamically effective at approximately 60 knots.

Flaps and slats provide high lift for takeoff, approach, and landing.

Symmetric spoilers are used as speedbrakes.

Flight Control Surface Locations

Actuator Control Electronics/Hydraulic Power Distribution



Primary Flight Control System Modes

There are three primary flight control system modes (flap and slat system modes are described later in this section):

- normal
- secondary
- direct.

All the modes use the same pilot controls and flight control surfaces.

Flight Control System Normal Mode

In the normal mode during manual flight, the ACES receive pilot control inputs and send these signals to the three PFCs. The PFCs verify these signals and information from other airplane systems in order to compute control surface commands. These commands are then sent back to the ACES. The four ACES send enhanced signals to the flight control surface actuators.

When the autopilot is engaged, the autopilot system sends commands to the PFCs. The PFCs generate control surface commands, which are then sent to the ACES in the same manner as pilot control inputs. The autopilot commands move the pilot controls to provide indications of what the autopilot is doing. If the pilot overrides the autopilot with control inputs, the PFCs disconnect the autopilot and use the pilot control inputs. The autopilot is only available during normal mode operation. Refer to Chapter 4, Automatic Flight, for autopilot operation.

After the hydraulic systems are shut down, the PFCs self-test. During the test, various EICAS alert and status messages display, trim indicator information blinks, and various failure indications display on the flight controls synoptic. When the self test is complete, the EICAS messages disappear, and the trim indicator and synoptic display return to normal. This happens about two minutes after the EICAS caution message HYD PRESS SYS L+C+R is displayed.

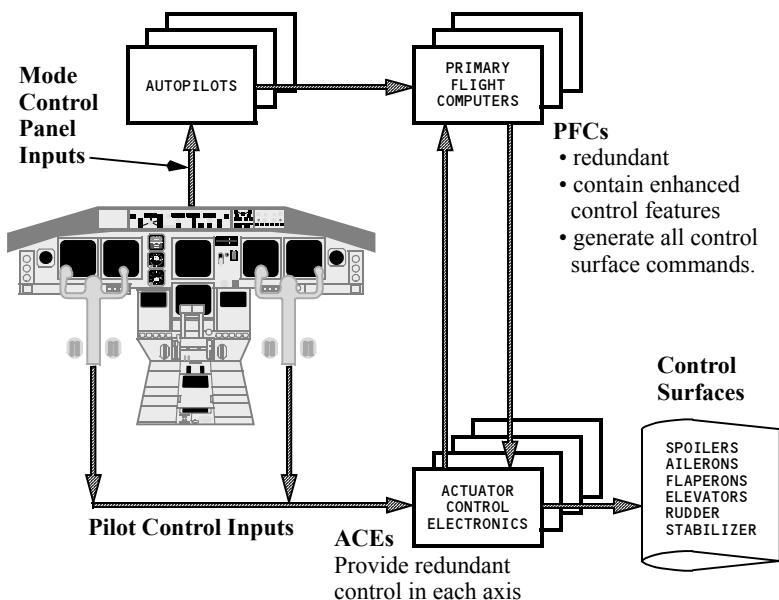
Flight Envelope Protection

The flight envelope protection system reduces the possibility of inadvertently exceeding the airplane's flight envelope. The flight envelope protection system provides crew awareness of envelope margins through tactile, aural, and visual cues. The protection functions do not reduce pilot control authority. The protection functions are described later in this section and include:

- stall protection
- overspeed protection
- roll envelope bank angle protection.

Normal Mode

Pilot or autopilot control inputs command the PFCs to generate control surface commands.



Flight Control System Secondary Mode

When the PFCs can no longer support the normal mode due to internal faults or lack of required information from other airplane systems, they automatically revert to the secondary mode. The ACEs continue to receive pilot control inputs and send these signals to the three PFCs. However, the PFCs use simplified computations to generate flight control surfaces commands. These simplified commands are sent back to the ACEs, where they are sent to the control surface actuators the same way as in the normal mode.

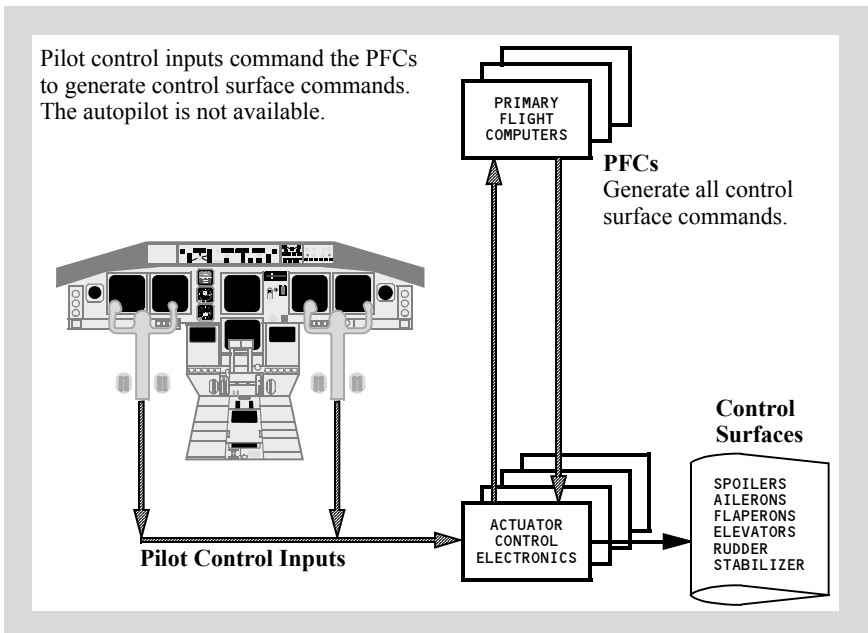
The simplified PFC control laws used in the secondary mode affect airplane handling qualities. All flight control surfaces remain operable. The elevator and rudder are more sensitive at some airspeeds.

The following functions are not available in the secondary mode:

- autopilot
- auto speedbrakes
- envelope protection
- gust suppression
- tail strike protection
- thrust asymmetry compensation
- yaw damping (may be degraded or inoperative).

The EICAS caution message FLIGHT CONTROL MODE is displayed when the primary flight control system is in the secondary mode. The secondary mode cannot be manually selected.

Secondary Mode



Flight Control System Direct Mode

The ACEs automatically transition to the direct mode when they detect the failure of all three PFCs or lose communication with the PFCs. The direct mode can also be manually selected by moving the PRIMARY FLIGHT COMPUTERS DISCONNECT switch to DISC.

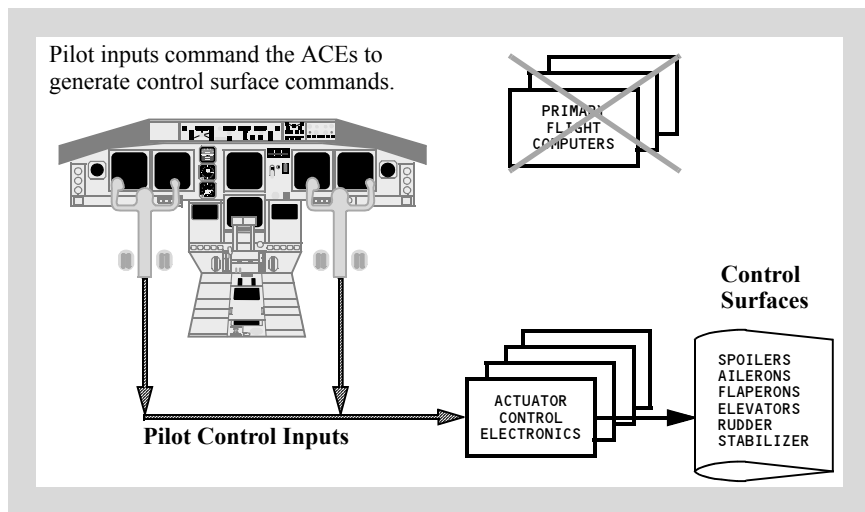
In the direct mode, the PFCs no longer generate control surface commands. Pilot inputs received by the ACEs are sent directly to the control surface actuators.

The direct mode provides full airplane control for continued safe flight and landing. Airplane handling qualities are approximately the same as in the secondary mode. The EICAS caution message PRI FLIGHT COMPUTERS is displayed when the system is in the direct mode.

In the direct mode, the following functions are not available:

- autopilot
- auto speedbrakes
- envelope protection
- gust suppression
- tail strike protection
- manual rudder trim cancel switch
- thrust asymmetry compensation
- yaw damping.

Direct Mode



Mechanical Backup

In the unlikely event of a complete electrical system shut-down, cables from the flight deck to the stabilizer and selected spoilers allow the pilot to fly straight and level until the electrical system is restarted.

Normal Mode Pitch Control

In the normal mode, airplane pitch control characteristics are like conventional airplanes, with improved handling qualities. Unlike conventional airplanes, the control column does not directly position the elevator in flight. The control column commands the PFCs to generate a pitch maneuver. The PFCs automatically position the elevator and the stabilizer to generate the commanded maneuver. The PFCs constantly monitor airplane response to pilot commands and reposition the elevator and stabilizer to carry out these commands. Airplane pitch responses to thrust changes, gear configuration changes, and turbulence are automatically minimized by PFC control surface commands.

The PFCs also provide compensation for flap and speedbrake configuration changes, and turns up to 30° of bank. The PFCs automatically control pitch to maintain a relatively constant flight path. This eliminates the need for the pilot to make control column inputs to compensate for these factors. For turns up to 30° of bank, the pilot does not need to add additional column back pressure to maintain altitude. For turns of more than 30° of bank, the pilot does need to add column back pressure.

As airspeed changes, the PFCs provide conventional pitch control characteristics by requiring the pilot to make control column inputs or trim changes to maintain a constant flight path.

Primary Pitch Trim Control

Primary pitch trim is controlled by the dual pitch trim switches on each control wheel. Both switches must be moved to command trim changes. The primary pitch trim switches are inhibited when the autopilot is engaged. Pitch trim does not move the control column.

In the normal mode, primary pitch trim operates differently on the ground than it does in flight. On the ground, the stabilizer is directly positioned when the pilot uses the pitch trim switches. In flight, the pitch trim switches do not position the stabilizer directly, but make inputs to the PFCs to change the trim reference speed. The trim reference speed is the speed at which the airplane would eventually stabilize if there were no control column inputs. Once the control column forces are trimmed to zero, the airplane maintains a constant speed with no column inputs. Thrust changes result in a relatively constant indicated airspeed climb or descent, with no trim inputs needed unless airspeed changes.

When pilot trim inputs are made, the PFCs automatically move the elevators to achieve the trim change, then move the stabilizer to streamline the elevator. Stabilizer motion may also automatically occur to streamline the stabilizer and elevator for thrust and configuration changes.

Alternate Pitch Trim

Alternate pitch trim is controlled by the dual alternate pitch trim levers on the control stand. Both levers must be moved to command trim changes. These levers move the trim reference airspeed (normal mode) and also move the stabilizer (all modes). The alternate pitch trim levers are linked to the stabilizer trim control modules (STCM) via control cables, and then mechanically to the stabilizer. Alternate pitch trim commands have priority over wheel pitch trim commands in all flight control modes.

Moving the alternate pitch trim levers with the autopilot engaged does not disconnect the autopilot, but does move the stabilizer. Moving the alternate pitch trim levers during stall or overspeed protection does move the stabilizer, but does not remove column forces.

Note: The alternate pitch trim levers should not be used with the autopilot engaged, or during stall or overspeed protection.

Pitch Envelope Protection

The pitch envelope protection functions include:

- stall protection
- overspeed protection.

Stall Protection

Stall protection reduces the likelihood of inadvertently exceeding the stall angle of attack by providing enhanced crew awareness of the approach to a stall or to a stalled condition.

Stall protection limits the speed to which the airplane can be trimmed. At approximately the minimum maneuvering speed, stall protection limits the trim reference speed so that trim is inhibited in the nose up direction. The pilot must apply continuous aft column force to maintain airspeed below the minimum maneuvering speed. Use of the alternate pitch trim levers does not reduce the column forces. When flying near stall speed, the column force increases to a higher level than would occur for an equivalent out-of-trim condition above the minimum maneuvering speed.

The autothrottle can support stall protection if armed and not activated. If speed decreases to near stick shaker activation, the autothrottle automatically activates in the appropriate mode (SPD or THR REF) and advances thrust to maintain minimum maneuvering speed (approximately the top of the amber band) or the speed set in the mode control panel speed window, whichever is greater. The EICAS message AIRSPEED LOW is displayed.

Note: When the pitch mode is FLCH or TOGA, or the airplane is below 400 feet above the airport on takeoff, or below 100 feet radio altitude on approach, the autothrottle will not automatically activate.

Note: During a descent in VNAV SPD, the autothrottle may activate in HOLD mode and will not support stall protection.

Refer to Chapter 10, Flight Instruments, Displays, for PFD indications.

Refer to Chapter 4, Automatic Flight, for an explanation of PFD flight mode annunciations, and for mode control panel and autothrottle operation.

Overspeed Protection

Overspeed protection limits the speed to which the airplane can be trimmed. At VMO/MMO, overspeed protection limits the trim reference speed so that trim is inhibited in the nose down direction. The pilot must apply continuous forward column force to maintain airspeed above VMO/MMO. Use of the alternate pitch trim levers does not reduce column forces.

Elevator Variable Feel

The PFCs calculate feel commands based on airspeed. In general, control column forces increase:

- as airspeed increases for a given column displacement, or
- as column displacement increases.

Tail Strike Protection

During takeoff or landing, the PFCs calculate if a tail strike is imminent and decrease elevator deflection, if required, to reduce the potential for tail skid ground contact. Activation of tail strike protection does not provide feedback to the control column.

Secondary and Direct Mode Pitch Control

Airplane pitch control is different in the secondary and direct flight control modes. The control columns now command a proportional elevator deflection instead of a maneuver command. Secondary and direct modes do not provide automatic pitch compensation for:

-
- | | |
|------------------------------|----------------------------|
| • thrust changes | • flap and speedbrake |
| • gear configuration changes | configuration changes |
| • turbulence | • turns to 30° bank angle. |
-

In secondary and direct modes, the elevator variable feel system provides two feel force levels instead of a continuous variation with airspeed. The force levels change with flap position. With the flaps up, the feel forces provide maneuver force levels that discourage overcontrol in the pitch axis at high speeds. With flaps extended (flaps 1 or greater), the feel forces decrease to provide force levels appropriate for approach and landing.

In the secondary and direct modes, both the primary pitch trim switches and the alternate pitch trim levers move the stabilizer directly. There is no trim reference speed.

Stabilizer Hydraulic Power and Non-Normal Operation

The stabilizer is powered by the center and right hydraulic systems. Stabilizer position commands from the PFCs and alternate pitch trim levers are sent to the stabilizer trim control modules, which control hydraulic power to the stabilizer. There are two modules, one for each stabilizer hydraulic source.

Stabilizer Shutdown

If uncommanded stabilizer motion is sensed, hydraulic power to the stabilizer trim control module that caused the motion is automatically shut off. If a module is inoperative due to an automatic shutdown or another failure, the EICAS advisory message STABILIZER C or STABILIZER R is displayed. The stabilizer remains operative through the remaining stabilizer trim control module.

If both stabilizer trim control modules automatically shut down or fail, the EICAS warning message STABILIZER is displayed. The STABILIZER warning is also displayed if automatic shutdown fails to stop uncommanded motion.

The center and right stabilizer cutout switches, located on the aisle stand, control hydraulic power to the respective stabilizer trim control module. Placing both switches in the CUTOUT position removes all hydraulic power from the stabilizer. The EICAS advisory message STABILIZER CUTOUT is displayed when both stabilizer cutout switches are in the CUTOUT position. The STABILIZER warning message is no longer displayed.

In the normal flight control mode, when the stabilizer is manually shut down or failed, pitch trim is still available. Pilot pitch trim inputs change the PFC trim reference speed. The PFCs then reposition the elevators to trim the airplane.

The control column can be used to interrupt pitch trim commands from the wheel pitch trim switches. This feature allows the pilot to quickly stop uncommanded trim changes due to stuck pitch trim switches. The pitch trim commands are interrupted if the control column is displaced in the opposing direction.

Stabilizer Position Indication and Greenband

Stabilizer position is displayed on two stabilizer position indicators located on the aisle stand. Stabilizer position is also displayed on the flight controls synoptic.

The stabilizer position indicators also display the takeoff green band indication. The green band automatically displays the acceptable range for takeoff stabilizer positions. There are three greenband segments that can be illuminated for takeoff:

- the midband
- the nose down band (which includes the midband)
- the nose up band (which includes the midband).

The greenband is calculated using the FMC inputs of CG, gross weight, and takeoff thrust. A nose gear oleo pressure switch provides an automatic cross-check of the CG to ensure that the correct greenband has been selected. When either the nose up or nose down band is selected, the pressure switch position is compared to the computed greenband. The EICAS advisory message STAB GREENBAND is displayed if the pressure switch and the greenband disagree. If the stabilizer signal is not present or is invalid, the greenband and the pointer are not displayed.

Normal Mode Roll Control

Roll control is similar to conventional airplanes. Aileron and flaperon surface deflections are proportional to control wheel displacement. Spoilers begin to extend to augment roll control after several degrees of control wheel rotation. Control wheel forces increase as control displacement increases. Control wheel forces do not change with airspeed changes. The ailerons are locked out at high speeds.

Spoilers 4 and 11 are mechanically controlled through a cable from the control wheel. These spoilers are available for roll control until the speedbrake lever is moved to near the UP position, when they function as speedbrakes only. Spoilers 5 and 10 are locked out at high speed.

Aileron Trim

Dual aileron trim switches located on the aisle stand must be pushed simultaneously to command trim changes. Use of aileron trim causes control wheel rotation.

The amount of aileron trim is indicated on a scale on the top of each control column.

Aileron trim is inhibited when the autopilot is engaged.

Roll Envelope Bank Angle Protection

Bank angle protection reduces the likelihood of exceeding the bank angle boundary due to external disturbances, system failures, or inappropriate pilot action.

Bank angle protection provides roll control wheel inputs when airplane bank angle exceeds the bank angle protection boundary of approximately 35°. If the boundary is exceeded, the control wheel force rolls the airplane back within 30° of bank. This roll command can be overridden by the pilot. Maximum control wheel deflection always commands maximum control surface deflection. The autopilot disengage bar disables bank angle protection.

Excessive bank angles are indicated on the PFD bank indicator. The indicator changes color to amber at bank angles exceeding 35°. Refer to Chapter 10, Flight Instruments, Displays, for PFD indications.

Secondary and Direct Mode Roll Control

Roll control in the secondary and direct modes is very similar to roll control in the normal mode. Bank angle protection is not available in either the secondary or direct mode. Spoilers 5 and 10 are always locked out.

Normal Mode Yaw Control

Yaw control operation is similar to a conventional airplane. Rudder surface deflections are proportional to rudder pedal movements.

Pedal forces increase as pedal displacement increases. Pedal forces do not change with airspeed changes.

The rudder ratio changer automatically reduces rudder deflection (for a given pedal input) as airspeed increases. This protects the vertical tail structure from stresses resulting from large rudder surface deflections at high airspeeds. Sufficient rudder authority is provided at all airspeeds to maintain airplane control in engine-out conditions, as well as during takeoffs and landings in crosswinds.

Thrust Asymmetry Compensation

The thrust asymmetry compensation (TAC) system significantly reduces uncommanded flight path changes associated with an engine failure. TAC continually monitors engine data to determine the thrust level from each engine. If the thrust level on one engine differs by 10 percent or more from the other engine, TAC automatically adds rudder to minimize yaw. TAC does not fully compensate for the failed engine so the pilot can recognize engine failure through roll/yaw cues. These roll/yaw cues are greatly reduced when compared to an airplane operating without TAC. The amount of rudder used is proportional to the engine thrust difference. Rudder movement is back-driven through the rudder pedals and displayed on the rudder trim indicator. Following engine failure, the pilot can trim the airplane using additional rudder trim, control wheel input, aileron trim, or autopilot engagement.

TAC is available except:

- when airspeed is below 70 knots on the ground, or
- when reverse thrust is applied, or
- when automatically disengaged due to system malfunction or loss of engine thrust data.

TAC automatically disengages if engine thrust data is lost. Also, if the engine is damaged or surges, TAC disengages because there is no accurate prediction of engine thrust. TAC may still cause some rudder deflection in the appropriate direction just before automatically disengaging.

TAC can be manually overridden by making manual rudder pedal inputs. TAC is only available in the normal flight control mode. To manually disarm TAC, push the THRUST ASYM COMP switch on the overhead panel. If TAC is automatically or manually disconnected, the EICAS advisory message THRUST ASYM COMP displays.

Wheel to Rudder Cross-Tie

A wheel to rudder cross-tie function provides the capability of being able to control the initial effects of an engine failure using control wheel inputs only. Control wheel inputs can deflect the rudder up to 8 degrees.

Wheel to rudder cross-tie is operative in flight below 210 knots in the normal mode.

Yaw Damping

In the normal mode, the yaw damping function provides turn coordination and Dutch roll damping.

Gust Suppression

A gust suppression function reduces the effects of lateral gusts and improves lateral ride quality through a combination of yaw and roll commands. Operation does not result in either rudder pedal or control wheel movement.

Rudder Trim

The rudder trim control can be used to command manual rudder trim in all three flight control modes. Two rudder trim speeds are available. Low rate rudder trim is commanded by rotating the control to the detent. High rate rudder trim is commanded by rotating the control past the detent. MANUAL TRIM CANCEL switch actuation causes manually set rudder trim to return to zero at the high speed trim rate. The switch has no effect on rudder trim inputs from TAC.

Secondary and Direct Mode Yaw Control

Secondary and direct mode yaw control is similar to normal mode yaw control. Pedal feel forces are unchanged from normal mode; however, rudder response is slightly different.

In secondary and direct modes, the rudder ratio changer is degraded to two fixed ratios determined by flap position. With flaps up, the rudder response to pedal inputs is less than with the flaps down.

In the secondary mode:

- gust suppression is inoperative
- yaw damping is degraded (for some failures, it may be inoperative)
- thrust asymmetry compensation is inoperative.

In the direct mode the following are inoperative:

- gust suppression
 - yaw damping
 - the manual rudder trim cancel switch
 - thrust asymmetry compensation.
-

Spoilers

There are 7 sets of spoilers, 5 outboard and 2 inboard of the flaperons, on the upper surface of each wing. The spoilers are numbered from left to right, 1 through 14. Spoilers on opposing wings are symmetrically paired.

Spoiler panels are used as speedbrakes to increase drag and reduce lift, both in flight and on the ground. The spoilers also supplement roll control in response to control wheel commands. Spoiler panels 5 and 10 are locked out during cruise, depending on altitude and airspeed.

All three hydraulic systems supply the spoilers. Each hydraulic system is dedicated to a different set of spoiler pairs to provide isolation and maintain symmetric operation in the event of hydraulic system failure. If a single spoiler fails, the corresponding spoiler on the other wing retracts. Failure of a single or multiple spoiler pairs causes the EICAS advisory message SPOILERS to display.

Spoiler Speedbrake Operation

The 14 spoiler panels are used as speedbrakes. In the normal mode, when used as speedbrakes, spoilers 5 and 10 are available as ground speedbrakes only. In the secondary and direct modes, spoilers 4, 5, 10, and 11 are locked out.

The speedbrake spoilers are controlled by the speedbrake lever located on the control stand. The speedbrake lever has three marked positions:

- DOWN
- ARMED
- UP.

The speedbrake lever can be placed in intermediate positions between ARMED and UP.

In the ARMED position, the speedbrake lever is driven aft to the UP position when the landing gear is fully on the ground (not tilted) and the thrust levers are at idle.

On the ground when either reverse thrust lever is moved to the reverse idle detent, the speedbrakes automatically extend. The speedbrake lever does not need to be in the ARMED position. A mechanical link between the speedbrake lever and the reverse thrust levers raises the speedbrake lever out of the DOWN detent. The speedbrake lever is then driven aft and the speedbrakes extend. If either thrust lever is advanced to a takeoff position, the speedbrake lever is driven to the down position.

Automatic speedbrakes are not available in the secondary and direct modes.

There is no limitation for extension of speedbrakes in a landing configuration.

Flaps and Slats

The flaps and slats are high lift devices that increase wing lift and decrease stall speed during takeoff, approach, and landing.

The airplane has an inboard and an outboard flap on the trailing edge of each wing, and one inboard and six outboard slats on the leading edge. A two-position Krueger flap provides a seal between the inboard slat and engine nacelle on each wing.

In the flaps 1 position, only the slats move. Flaps 5, 15, and 20 are takeoff flap positions. Flaps 25 and 30 are landing flaps positions. Flaps 20 is used for some non-normal landing conditions.

[777-200]

To protect against inadvertent deployment during cruise, flap and slat extension from the UP position is inhibited when speed is more than 250 knots or altitude is above approximately 20,000 feet.

[777-200ER and 777-300]

To protect against inadvertent deployment during cruise, flap and slat extension from the UP position is inhibited when speed is more than 265 knots or altitude is above approximately 20,000 feet.

[777-200LR, 777F, and 777-300ER]

To protect against inadvertent deployment during cruise, flap and slat extension from the UP position is inhibited when speed is more than 275 knots or altitude is above approximately 20,000 feet.

If the flap handle is moved out of UP while the flaps are inhibited, LOAD RELIEF displays.

Flap and Slat Sequencing

When the flap lever is in the UP detent, all flaps and slats are commanded retracted. Moving the flap lever aft allows selection of flap detent positions 1, 5, 15, 20, 25 and 30. The flaps and slats sequence so that the slats extend first and retract last.

Starting from flaps UP, selection of flaps 1 commands the slats to move to the midrange position. The flaps remain retracted.

Selection of the flaps 5, 15, and 20 positions commands the flaps to move to the position selected. The slats remain in the midrange position.

Selection of flaps 25 commands both the flaps and slats to move to landing positions. First the slats extend to the fully extended position, then the flaps extend to the landing flaps 25 position.

Selection of flaps 30 commands the flaps to extend to the primary landing position.

During retraction, flap and slat sequencing is reversed.

The mechanical gate at the flaps 20 detent prevents inadvertent retraction of the flaps past the go-around flap setting. The mechanical gate at flaps 1 prevents inadvertent retraction of the slats past the midrange position.

Flap and Slat Modes

Three modes of flap and slat operation are possible:

- primary (hydraulic)
- secondary (electric)
- alternate (electric).

The flaps and slats can operate independently in either the primary or secondary mode. However, independent flap and slat operation in the alternate mode is not possible.

Primary mode hydraulic power is supplied by the center hydraulic system.

Secondary and alternate mode electrical power is supplied by the left and right AC busses.

The secondary mode is automatically engaged whenever the primary mode fails to move the flaps or slats to the selected position. Once engaged, the secondary mode remains engaged until the affected system surfaces are fully retracted or center hydraulic system pressure is restored.

[777-200]

In the secondary mode, the flaps and slats are positioned by electric motors. Because autoslats are unavailable, the slats are fully extended at all flap positions (if airspeed is less than 215 knots) to improve stall handling characteristics. If airspeed exceeds 215 knots, the slats retract to the midrange position (the midrange index on the slat position indicator), or will not extend beyond the midrange position.

[777-200ER]

In the secondary mode, the flaps and slats are positioned by electric motors. Because autoslats are unavailable, the slats are fully extended at all flap positions (if airspeed is less than 239 knots) to improve stall handling characteristics. If airspeed exceeds 239 knots, the slats retract to the midrange position (the midrange index on the slat position indicator), or will not extend beyond the midrange position.

[777-300]

In the secondary mode, the flaps and slats are positioned by electric motors. Because autoslats are unavailable, the slats are fully extended at all flap positions (if airspeed is less than 246 knots) to improve stall handling characteristics. If airspeed exceeds 246 knots, the slats retract to the midrange position (the midrange index on the slat position indicator), or will not extend beyond the midrange position.

[777-200LR, 777F, and 777-300ER]

In the secondary mode, the flaps and slats are positioned by electric motors. Because autoslats are unavailable, the slats are fully extended at all flap positions (if airspeed is less than 256 knots) to improve stall handling characteristics. If airspeed exceeds 256 knots, the slats retract to the midrange position (the midrange index on the slat position indicator), or will not extend beyond the midrange position.

If the slats are in the midrange position (flaps 1 through 20) when the secondary mode is engaged, they remain in that position until the flaps are retracted to UP, or extended beyond 20.

On the ground, secondary electric mode extension or retraction is inhibited when groundspeed is less than 40 knots, center hydraulic system pressure is low, and two of the following three items are true:

[GE, PW Engines]

- left engine N2 is less than 50 percent,
- right engine N2 is less than 50 percent,
- primary external power is available.

[RR Engines]

- left engine N3 is less than 50 percent,
- right engine N3 is less than 50 percent,
- primary external power is available.

The alternate mode allows direct manual operation of the flaps and slats through the secondary drive electric motors. The alternate flaps ARM switch:

- disables normal control
- engages the electric motors
- arms the alternate mode
- the flap lever no longer controls flaps/slats.

The three-position alternate flaps selector extends and retracts the flaps and slats. The flaps and slats extend simultaneously, but slat retraction is inhibited until the flaps are up. Alternate mode flap and slat extension is limited to slats midrange and flaps 20. Asymmetry protection, uncommanded motion protection, autoslats, and flap/slat load relief are not available in the alternate mode.

The alternate mode must be manually selected. Slat and flap operation time in the secondary and alternate modes is greatly increased.

Flap/Slat Load Relief

In the primary mode, the flap load relief system protects the flaps from excessive air loads. If flap airspeed placard limits are exceeded with the flaps in the 15 through 30 position, LOAD RELIEF is displayed and the flaps automatically retract to a position appropriate to the airspeed. Load relief retraction is limited to flaps 5.

When airspeed is reduced, the flaps automatically re-extend as airspeed allows. Re-extension is limited to the commanded flap position.

If a flap overspeed exists, load relief prevents flap extension beyond the 5, 15, 20, or 25 positions until airspeed is sufficiently reduced. Flap load relief is available only in the primary mode. The EICAS flap display indicates an in-transit flap condition and shows actual flap position. The flap lever does not move during flap load relief operation. Load relief for slats is not required in the primary or alternate modes.

[\[777-200\]](#)

Slat load relief is available in the secondary mode. If airspeed exceeds 215 knots with the slats fully extended, they retract to midrange and LOAD RELIEF is displayed.

[\[777-200ER\]](#)

Slat load relief is available in the secondary mode. If airspeed exceeds 239 knots with the slats fully extended, they retract to midrange and LOAD RELIEF is displayed.

[\[777-300\]](#)

Slat load relief is available in the secondary mode. If airspeed exceeds 246 knots with the slats fully extended, they retract to midrange and LOAD RELIEF is displayed.

[\[777-200LR, 777F, and 777-300ER\]](#)

Slat load relief is available in the secondary mode. If airspeed exceeds 256 knots with the slats fully extended, they retract to midrange and LOAD RELIEF is displayed.

Autoslats

The autoslat system enhances airplane stall characteristics. Upon receiving a signal from the stall warning system, the slats automatically extend from the midrange position to the fully extended landing position. The slats retract a few seconds after the signal is removed. Slats are fully extended to improve stall handling characteristics.

Autoslat operation is armed at flaps 1, 5, 15 and 20 and is available only in the primary slat mode.

Flap and Slat Asymmetry Detection

A detection system detects asymmetrical extension or retraction of an individual flap. After detection, the flap drive shuts down and the EICAS message FLAPS DRIVE is displayed.

A detection system detects slat asymmetry. Loss of all but the most outboard slats on each wing is also detected. When slat loss or asymmetry occurs, the system shuts down the slat drive and displays the SLATS DRIVE EICAS message.

Uncommanded Flap or Slat Motion

Uncommanded motion is detected when the slats or flaps:

- move away from the commanded position
- continue to move after reaching a commanded position
- or move in a direction opposite to that commanded.

If the flap or slat is operating in the primary mode, uncommanded motion first causes an automatic transfer to the secondary mode. The EICAS message FLAPS PRIMARY FAIL or SLATS PRIMARY FAIL is displayed. If motion continues, the system shuts down. The EICAS message FLAPS DRIVE or SLATS DRIVE is displayed.

Flap Indications

Flap position indications are displayed on the primary EICAS display. A single vertical indicator displays combined flap and slat position. The position commanded by the flap lever is also displayed. Ten seconds after all flaps and slats are up, the entire indication is no longer displayed. A loss of position sensing removes the tape fill and flap lever position indications.

If flap/slat control is in the secondary or alternate mode, or if any non-normal condition is detected, an expanded flap indication is displayed automatically. The position of the left and right flaps and slats are separately indicated. In the alternate mode, the position commanded by the flap lever is replaced by flap position index marks at all flap and slat positions, and numbers at flaps 5 and flaps 20. The index marks are used as a guide to position the flaps to the desired setting.

Flight Controls
EICAS Messages**Chapter 9**
Section 30**Flight Control System EICAS Messages**

Note: Configuration (CONFIG) warning messages are described in Chapter 15, Warning Systems.

The following EICAS messages can be displayed.

Message	Level	Aural	Message Logic
AUTO SPEEDBRAKE	Advisory		A fault is detected in the automatic speedbrake system.
FLAPS DRIVE	Caution	Beeper	Flap drive mechanism has failed.
FLAPS PRIMARY FAIL	Caution	Beeper	Flaps are operating in the secondary mode.
FLAP/SLAT CONTROL	Caution	Beeper	Flap/slat electronics units are inoperative.
FLIGHT CONTROL MODE	Caution	Beeper	Flight control system is operating in the secondary mode.
FLIGHT CONTROLS	Caution	Beeper	Multiple flight control surfaces are inoperative or other flight control system faults are detected.
FLT CONTROL VALVE	Advisory		One or more flight control valves are failed closed or one or more flight control shutoff switches are in SHUTOFF.
PITCH DOWN AUTHORITY	Caution	Beeper	Pitch down authority is limited.
PITCH UP AUTHORITY	Caution	Beeper	Pitch up and flare authority is limited.
PRI FLIGHT COMPUTERS	Caution	Beeper	Flight control system is operating in the direct mode.
SLATS DRIVE	Caution	Beeper	Slat drive mechanism has failed.
SLATS PRIMARY FAIL	Caution	Beeper	Slats are operating in the secondary mode.
SPEEDBRAKE ARMED	Memo		Speedbrakes are armed.

Message	Level	Aural	Message Logic
SPEEDBRAKE EXTENDED	Caution	Beeper	Speedbrake is extended when radio altitude is between 15 and 800 feet, or when the flap lever is in a landing position, or when either thrust lever is not closed.
SPOILERS	Advisory		One or more spoiler pairs are inoperative.
STAB GREENBAND	Advisory		Nose gear pressure switch disagrees with computed stabilizer greenband.
STABILIZER	Warning	Siren	Uncommanded stabilizer motion is detected or stabilizer is inoperative.
STABILIZER C	Advisory		Center stabilizer control path is inoperative.
STABILIZER CUTOUT	Advisory		Both stabilizer cutout switches are in CUTOUT.
STABILIZER R	Advisory		Right stabilizer control path is inoperative.
THRUST ASYM COMP	Advisory		Thrust asymmetry compensation is inoperative.

Flight Instruments, Displays**Chapter 10****Table of Contents****Section 0**

Controls and Indicators	10.10
Primary Flight Display (PFD)	10.10.1
PFD Indications	10.10.1
PFD Airspeed Indications	10.10.3
PFD Reference Speeds	10.10.5
PFD VNAV Speed Band	10.10.7
PFD Angle of Attack (AOA) Indications	10.10.8
PFD Attitude Indications	10.10.9
PFD Steering Indications	10.10.11
PFD Radio Altitude Indications	10.10.13
PFD Navigation Performance Indications	10.10.14
PFD Instrument Landing System Indications	10.10.15
PFD Expanded Localizer Indications	10.10.17
PFD Rising Runway Indications	10.10.17
PFD Altitude Indications	10.10.18
PFD Landing Altitude/Minimums Indications	10.10.19
PFD Barometric Indications	10.10.20
PFD Vertical Speed Indications	10.10.22
PFD Heading/Track Indications	10.10.23
PFD Failure Flags	10.10.24
Navigation Display (ND)	10.10.25
ND Map Mode	10.10.25
Centered Map Mode	10.10.27
ND Grid Heading Display	10.10.29
ND Navigation Performance Indications	10.10.30
ND Weather Radar System Display Indications	10.10.30
ND Approach Mode	10.10.32
ND VOR Mode	10.10.33
ND Plan Mode	10.10.34
ND Failure Indications and Flags	10.10.34
ND Failure Messages	10.10.34
ND Failure Flags	10.10.35

Ground Maneuver Camera System	10.10.36
EFIS Control Panels	10.10.38
EFIS Control Panel PFD Controls	10.10.38
EFIS Control Panel ND Controls	10.10.39
Instrument Source Select Panels	10.10.42
Heading Reference and Inboard Displays	10.10.43
Inboard Display Controls	10.10.43
Heading Reference Controls	10.10.44
Display Select Panel	10.10.45
Flight Deck Entry Video Surveillance System (FDEVSS)	10.10.46
Flight Deck Entry Video Panel	10.10.46
Cursor Control Device (CCD)	10.10.48
Display Brightness Controls	10.10.49
Standby Flight Instruments	10.10.51
Integrated Standby Flight Display (ISFD)	10.10.51
Standby Magnetic Compass	10.10.55
Standby Attitude Indicator	10.10.56
Standby Airspeed Indicator	10.10.58
Standby Altimeter	10.10.60
Clock	10.10.61
EFIS Control Panels and Display Select Panel (DSP) – CDU Alternate Control	10.10.63
CDU EFIS/DSP Control Selection	10.10.63
EFIS Control CDU Pages	10.10.64
Display Select CDU Pages	10.10.65
System Description	10.20
Introduction	10.20.1
Display Selection and Control	10.20.1
Inboard Display Selectors	10.20.1
EFIS Control Panels	10.20.2
Display Select Panel	10.20.2
Display Brightness Control	10.20.4

Instrument Display Source Selection	10.20.4
Display Selection and Control Examples	10.20.5
Ground Maneuver Camera System	10.20.10
Flight Deck Entry Video Surveillance System (FDEVSS)	10.20.10
Control and Operation	10.20.11
Cursor Control Devices (CCD)	10.20.11
CCD Touch Pad	10.20.11
CCD Cursor Location Control	10.20.12
Standby Flight Instruments	10.20.12
Integrated Standby Flight Display (ISFD)	10.20.13
Standby Attitude Indicator	10.20.13
Standby Airspeed Indicator	10.20.13
Standby Altimeter	10.20.14
Standby Magnetic Compass	10.20.14
Clocks	10.20.14
Display System Information Sources	10.20.14
Air Data Inertial Reference System (ADIRS)	10.20.14
Primary Flight Displays (PFDs)	10.30
Introduction	10.30.1
Airspeed	10.30.1
Ground Speed	10.30.2
Altitude	10.30.2
Vertical Speed	10.30.3
Attitude	10.30.3
Steering Indications	10.30.3
Radio Altitude	10.30.4
Angle of Attack	10.30.4
Instrument Landing System Indications	10.30.4
Approach Minimums	10.30.5
Heading/Track Indications	10.30.5
Engine Fail, GPWS, and PWS Alerts	10.30.5

Typical PFD Displays	10.30.5
Navigation Displays.....	10.40
Introduction	10.40.1
Map Mode	10.40.1
Navigation Data Points	10.40.1
VOR and Approach Modes	10.40.1
Plan Mode.....	10.40.2
ND Information	10.40.2
Heading	10.40.2
Track	10.40.2
Traffic	10.40.2
Weather Radar.....	10.40.2
Failure Flags and Messages	10.40.2
Typical ND Map Displays	10.40.3
ND Symbology	10.40.10
Electronic Checklist Displays.....	10.50
Normal Checklist	10.50.1
Non-Normal Checklist Queue	10.50.3
Non-Normal Checklist.....	10.50.4
Checklist Timer	10.50.5
Operational Note	10.50.6
Conditional Line Item	10.50.8
Deferred Line Item.....	10.50.10
Inhibit Checklist Line Item.....	10.50.12
Checklist Override	10.50.13
Checklists Menu Page	10.50.14
Resets Menu Page	10.50.15
Electronic Checklist Description	10.60
Introduction	10.60.1

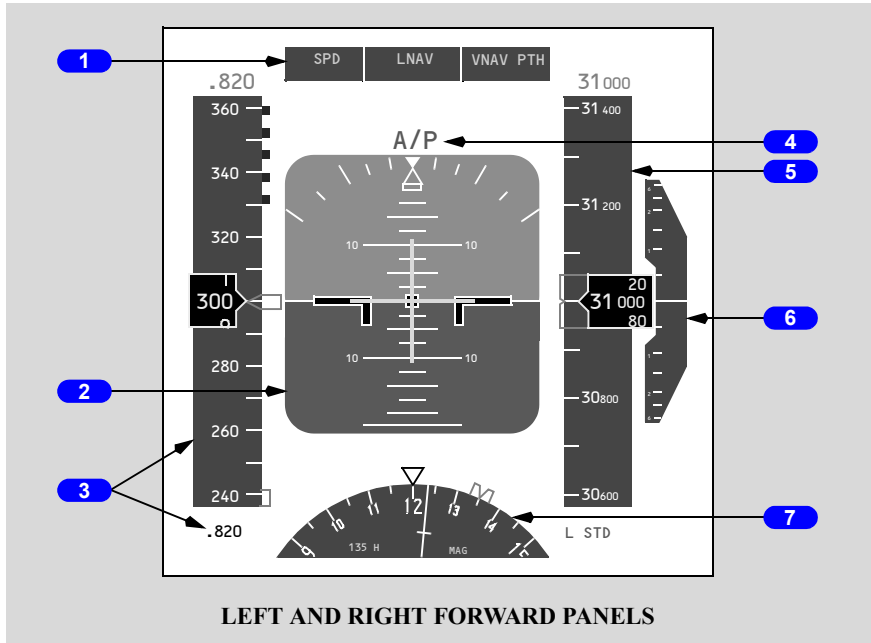
777 Flight Crew Operations Manual

Electronic Checklist Operation	10.60.1
Checklist Status	10.60.1
Checklist Pages	10.60.2
Checklist Line Items	10.60.2
Closed Loop Line Items	10.60.2
Open Loop Line Items	10.60.3
Operational Notes	10.60.3
Deferred Line Items	10.60.3
Conditional Line Items	10.60.4
Inhibit Checklist Line Items	10.60.4
Timers	10.60.5
Checklist Menu Operation	10.60.5
Normal Menu	10.60.5
Non-Normal Menu	10.60.6
Resets Menu	10.60.6
Dual Database	10.60.6
Checklist Access	10.60.6
Normal Checklists	10.60.7
Normal Checklist Access	10.60.7
Normal Checklist Completion	10.60.7
Non-Normal Checklists	10.60.7
Non-Normal Checklist Access and Checklist Icon	10.60.8
Non-Normal Checklist Completion	10.60.9
Non-Normal Unannunciated Checklists	10.60.9
Checklist Resets	10.60.9
Normal Checklist Automatic Reset Conditions	10.60.9
Normal Checklist Manual Resets	10.60.10
Non-Normal Checklist Manual Resets	10.60.10
Manual Reset All	10.60.10
Overrides	10.60.10
Item Override	10.60.10
Checklist Override	10.60.11
Electronic Checklist System Inoperative	10.60.11

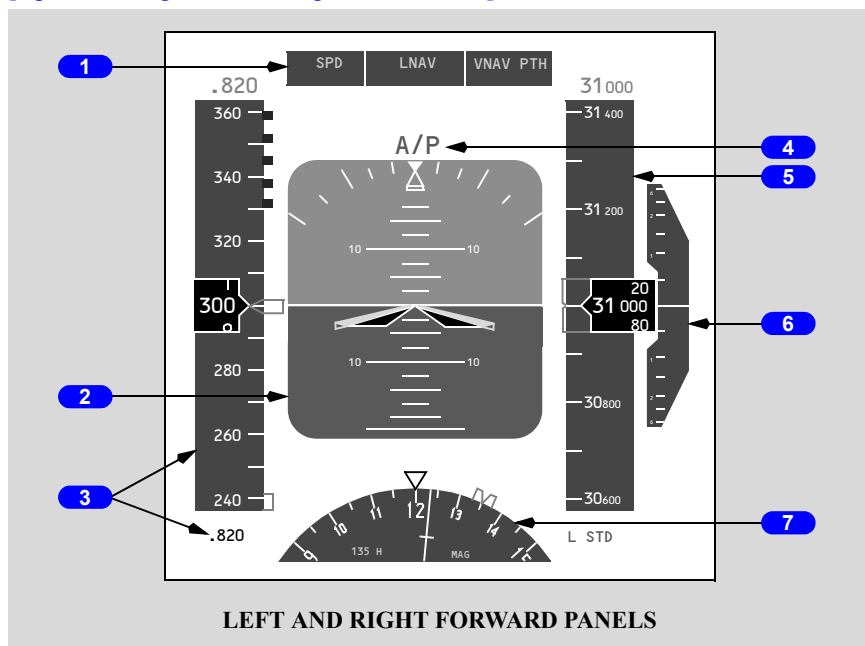
Electronic Flight Bag (EFB).	10.65
Introduction	10.65.1
Display Unit	10.65.2
Display Description.	10.65.4
Main Menu (Typical)	10.65.6
Airport Maps (Typical)	10.65.9
IDENT page (Typical)	10.65.16
SYSTEM page (Typical).	10.65.18
Documents (Typical).	10.65.20
Performance (Typical)	10.65.23
Video Surveillance (Typical)	10.65.29
Logbook (Typical)	10.65.33
EICAS Messages	10.70
Flight Instruments, Displays EICAS Messages	10.70.1

Flight Instruments, Displays
Controls and Indicators**Chapter 10**
Section 10**Primary Flight Display (PFD)****PFD Indications**

[Option – Basic, Split Cue Flight Director Bars]



[Option – Integrated Cue Flight Director Bar]



LEFT AND RIGHT FORWARD PANELS

1 Flight Mode Annunciations

Refer to Chapter 4, Automatic Flight.

2 Attitude, Steering, and Miscellaneous Indications

Displays Air Data Inertial Reference System (ADIRS) attitude information.

3 Airspeed/Mach Indications

Displays ADIRS airspeed information and other airspeed related information.

4 Autopilot, Flight Director System Status

Refer to Chapter 4, Automatic Flight.

5 Altitude Indications

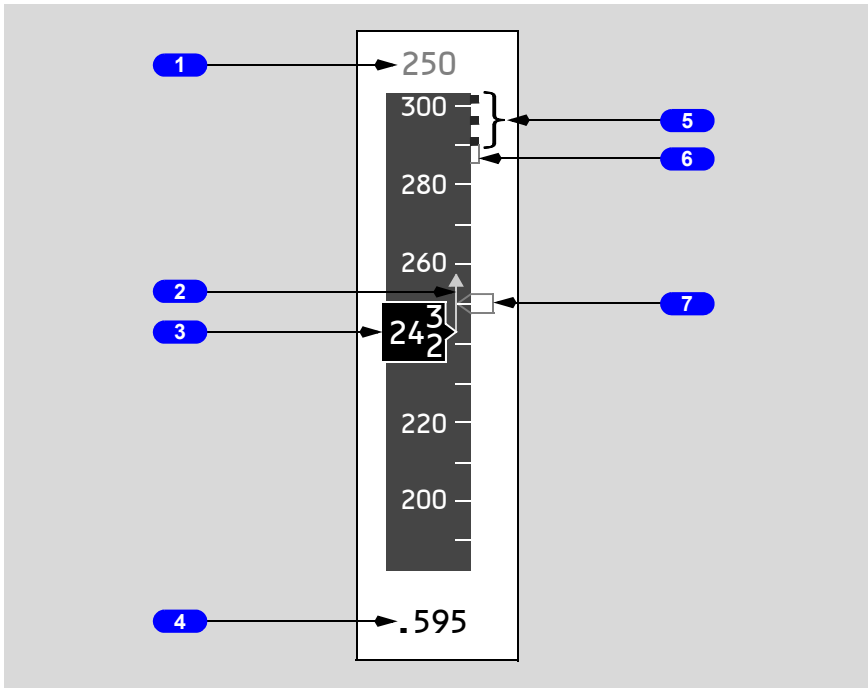
Displays ADIRS altitude and other altitude-related information.

6 Vertical Speed Indication

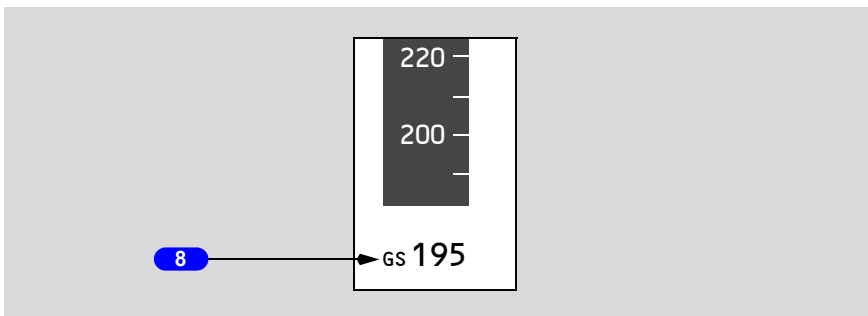
Displays ADIRS vertical speed and other vertical speed information.

7 Heading and Track Indications

Displays current ADIRS heading, track and other heading information.

PFD Airspeed Indications

[Option - Mach/Ground Speed Display]

**1 Selected Speed**

Displays the airspeed/Mach selected in the mode control panel MCP IAS/MACH window (refer to Chapter 4, Automatic Flight).

Displays the FMC-computed airspeed/Mach when the MCP IAS/MACH window is blank.

2 Speed Trend Vector

Indicates predicted airspeed in ten seconds based on current acceleration or deceleration.

3 Current Airspeed

Indicates current ADIRS airspeed.

The box around the current airspeed indication turns amber when airspeed is below minimum maneuvering speed.

4 Current Mach

Displays current ADIRS Mach at or above 0.40.

5 Maximum Speed

Indicates maximum permissible airspeed as limited by the lowest of the following:

- Vmo/Mmo
- landing gear placard speed, or
- flap placard speed.

6 Maximum Maneuvering Speed

When displayed, indicates maneuver margin to high speed buffet. Bottom of the bar is the airspeed that provides 1.3 g maneuver capability (or an alternative approved maneuver capability as preset by maintenance). Bar may be displayed when operating at high altitude at relatively high gross weights.

Note: 1.3 g maneuver capability occurs at 40 degrees of bank in level flight.

7 Speed Bug

Points to the airspeed/Mach selected in the MCP IAS/MACH window.

Indicates FMC-computed airspeed when the MCP IAS/MACH window is blank.

The bug is five knots in height.

When the selected speed is off scale, the bug is parked at the top or bottom of the tape, with only one half the bug visible.

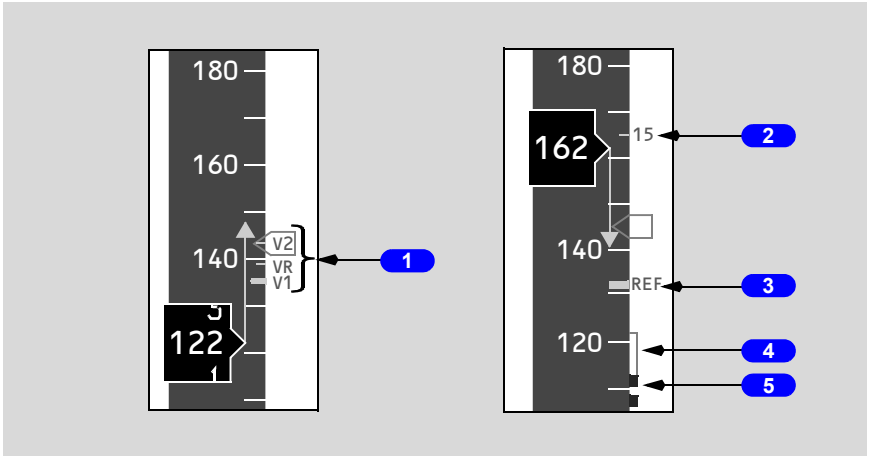
8 Current Ground Speed

[Option - Mach/Ground Speed Display]

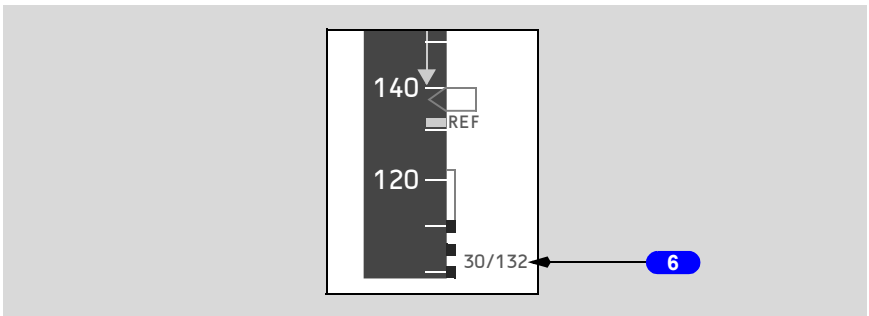
Displays ground speed when Mach number is less than 0.40.

When a transition occurs between the display of ground speed and Mach number, the new display is highlighted with a white box for 10 seconds.

PFD Reference Speeds



[Option – landing flaps and VREF speed at bottom of speed tape]



1 Takeoff Reference Speeds

Displays the takeoff reference speeds V1, VR (displays R if VR is within 4 knots of V1 or V2), and V2, selected on the CDU (refer to Chapter 11, Flight Management, Navigation):

- displayed for takeoff
- NO V SPD is displayed if V speeds are not selected on the CDU
- V1 is displayed at the top of the airspeed indication when selected and if the value is off the scale
- V1 and VR are removed at lift-off
- V2 is removed on climb-out:
 - when flap retraction begins, or

- after 10 minutes have passed without flap lever movement, or
- after VREF has been selected (for a turn-back).

2 Flap Maneuvering Speeds

Indicates flap maneuvering speed for flap retraction or extension.

Not displayed above approximately 20,000 feet altitude.

3 Landing Reference Speed

Displays the VREF speed as selected on the CDU (refer to Chapter 11, Flight Management, Navigation).

4 Minimum Maneuvering Speed

Indicates maneuver speed margin to stick shaker or low speed buffet. Top of the bar is the airspeed that provides:

- 1.3 g maneuver capability to stick shaker with flaps down.
- 1.3 g maneuver capability to stick shaker or VREF + 80, whichever is less, with flaps up below 20,200 FT.
- 1.3 g maneuver capability to low speed buffet (or an alternative approved maneuver capability as preset by maintenance), with flaps up above 20,200 FT.

Displayed with first flap retraction after takeoff.

Note: 1.3 g maneuver capability occurs at 40 degrees of bank in level flight.

5 Minimum Speed

Indicates the airspeed where stick shaker activates.

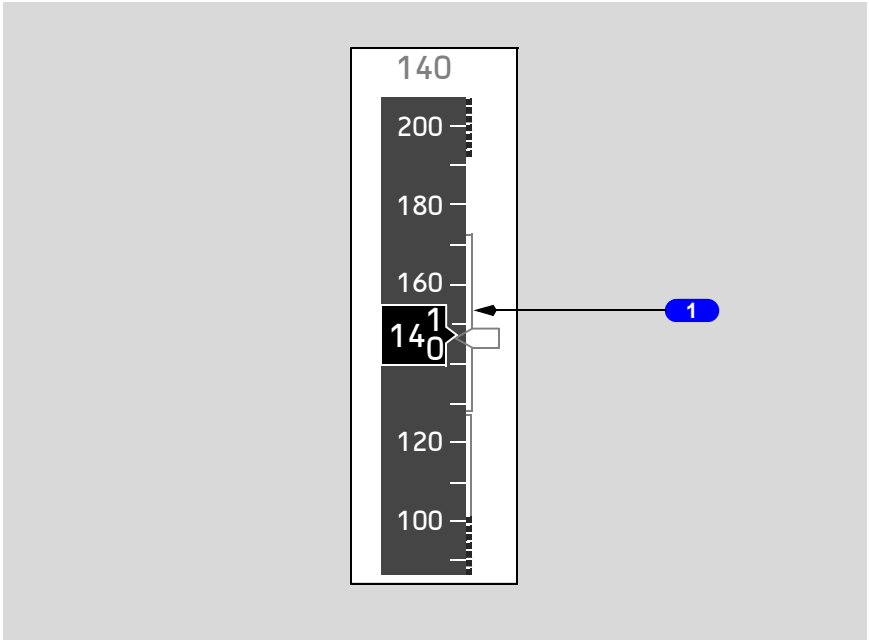
6 Selected Landing Flap and VREF Speed

[Option – Landing Flaps and VREF Speed at Bottom of Speed Tape]

Landing flap and VREF speed are displayed at the bottom of the airspeed indication.

PFD VNAV Speed Band

[Option - VNAV Speed Band]



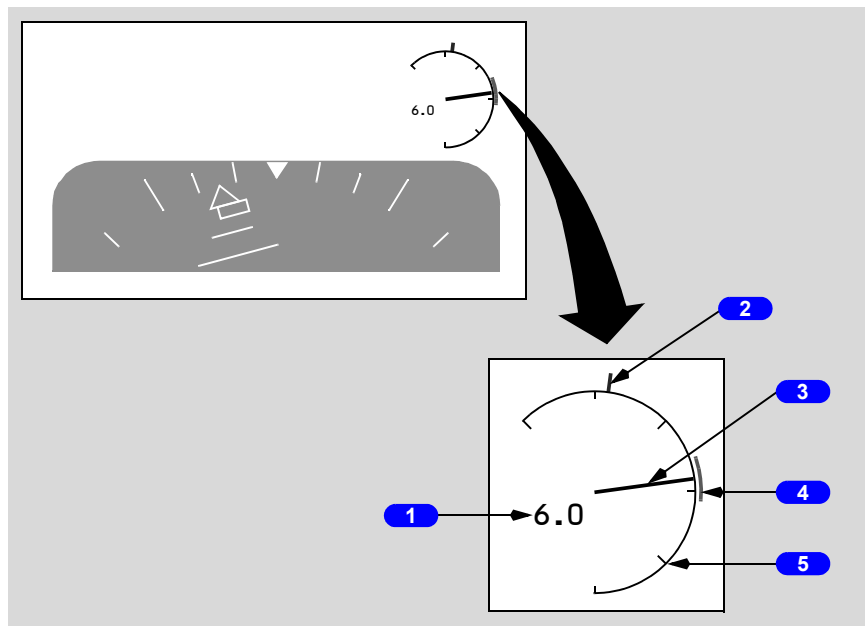
1 VNAV Speed Band

Indicates acceptable airspeed range for VNAV path (VNAV PTH) pitch mode. Available with flaps up.

PFD Angle of Attack (AOA) Indications

[Option - AOA Indication]

The angle of attack indications display ADIRU aircraft body angle of attack.



1 Digital AOA Readout

Indicates digital AOA value to the nearest 0.2 degrees. When on the ground and ground speed less than 80 knots, the readout is fixed at 0.0 degrees. Captain and first officer values can differ by 0.2 degrees.

2 Stick Shaker Indicator

Indicates point at which stick shaker activation occurs for existing flight conditions, blank if AOA signal is invalid.

3 Analog Needle

Indicates analog AOA value.

- needle travel is limited to a range of -6 degrees and +21 degrees
- fixed at 0.0 degrees when on the ground and ground speed is less than 80 knots.

4 Approach Reference Band

Indicates appropriate range of approach AOA for a $V_{ref}(xx) + 5$ approach.

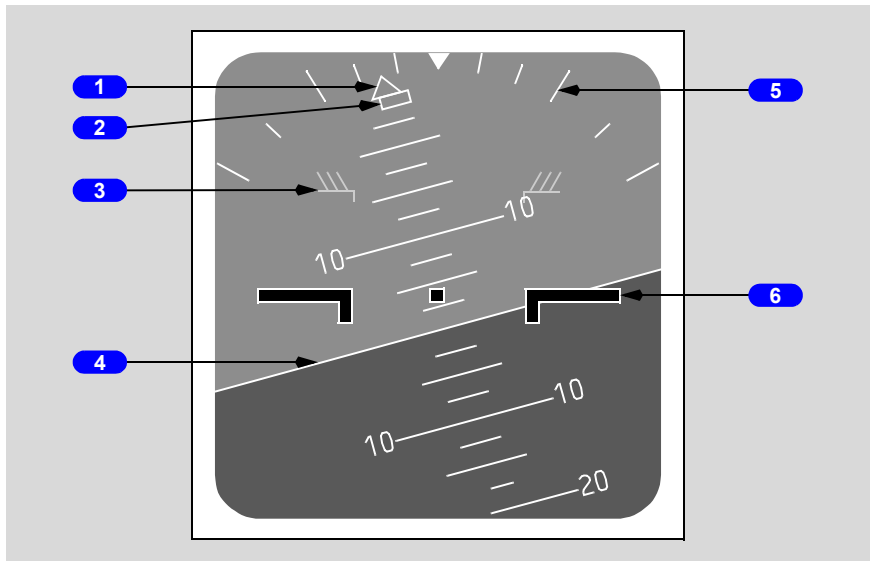
- displayed when in normal or single engine landing flaps (20, 25, 30)
- moves with flap position
- inhibited on takeoff and initial climb.

5 Zero Degree Reference Line

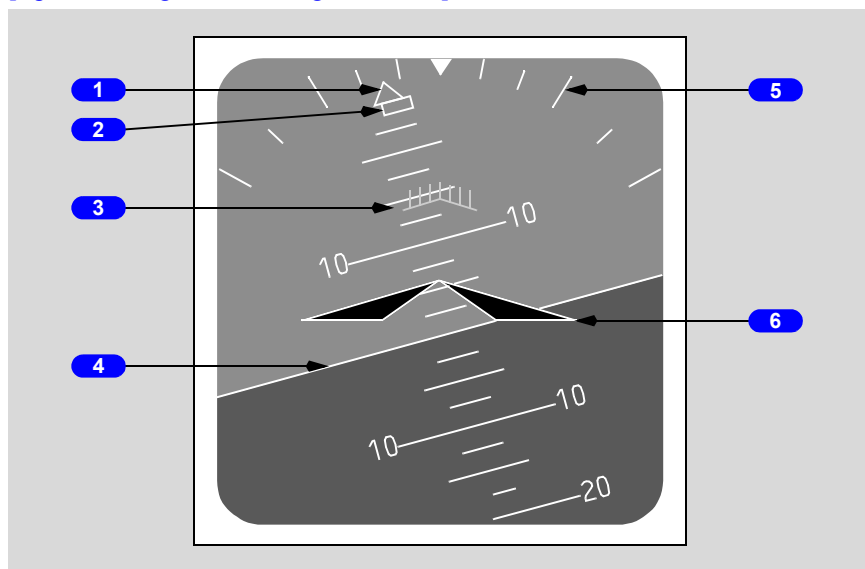
Indicates zero degrees angle of attack. Reference lines are displayed every 5 degrees from -5 degrees to +20 degrees.

PFD Attitude Indications

[Option – Basic, Split Cue Flight Director]



[Option – Integrated Cue Flight Director]



1 Bank Pointer

Indicates ADIRS bank in reference to the bank scale.

Fills and turns amber if bank angle is 35 degrees or more.

2 Slip/Skid Indication

Displaces beneath the bank pointer to indicate slip or skid.

Fills white at full scale deflection.

Turns amber if bank angle is 35 degrees or more; fills amber if the slip/skid indication is also at full deflection.

3 Pitch Limit Indication

Indicates pitch limit (stick shaker activation point for the existing flight conditions).

Displayed when the flaps are not retracted, or at slow speeds with the flaps retracted.

4 Horizon Line and Pitch Scale

Indicates the ADIRS horizon relative to the airplane symbol.

Pitch scale is in 2.5 degree increments.

5 Bank Scale

Fixed reference for the bank pointer.

Scale marks are at 0, 10, 20, 30, 45, and 60 degrees.

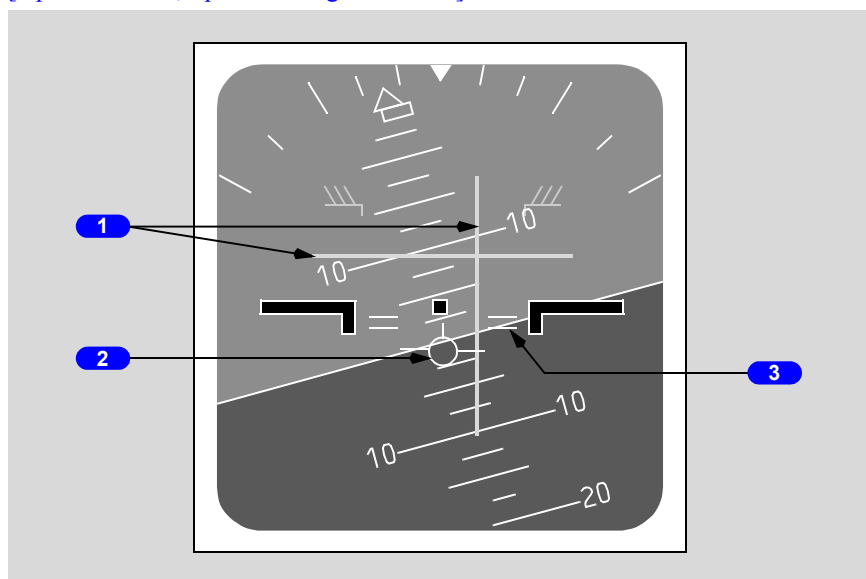
6 Airplane Symbol

Indicates airplane attitude with reference to the ADIRS horizon.

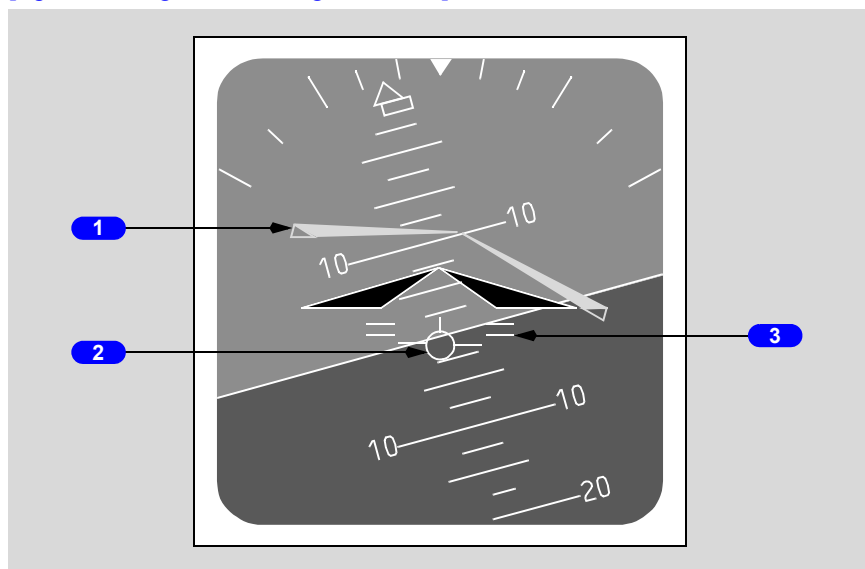
PFD Steering Indications

Note: Refer to Chapter 15, Warning Systems, for TCAS Steering Indications and Time Critical Warnings.

[Option – Basic, Split Cue Flight Director]



[Option – Integrated Cue Flight Director]



1 Flight Director Pitch and Roll Bars

[Option – Split Cue Flight Director]

Indicates flight director pitch and roll steering commands.

Refer to Chapter 4, Automatic Flight.

1 Flight Director Bar

[Option – Integrated Cue Flight Director]

Indicates flight director pitch and roll steering commands.

Refer to Chapter 4, Automatic Flight.

2 Flight Path Vector (FPV)

Displays flight path angle and drift angle if:

- FPV is selected on the EFIS control panel, or
- FPA (flight path angle) is selected on the MCP.

Flight path angle is displayed relative to the horizon line.

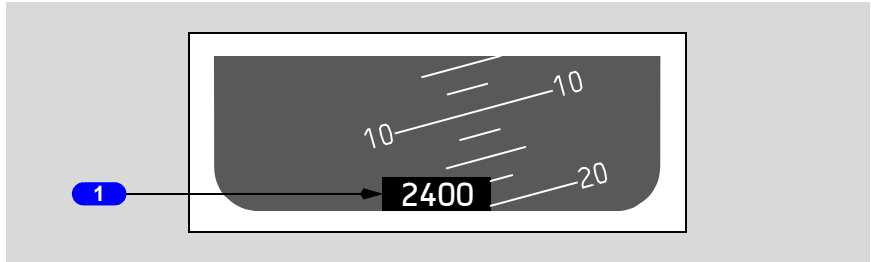
Drift angle is represented by the perpendicular distance from the centerline of the pitch scale to the FPV symbol.

3 Selected Flight Path Angle (FPA)

Indicates the selected flight path angle when FPA is selected on the MCP.

PFD Radio Altitude Indications

[Option – Basic Numeric RA Display]

**1 Radio Altitude**

Displays radio altitude below 2500 feet AGL.

[Option – Basic Numeric RA Display]

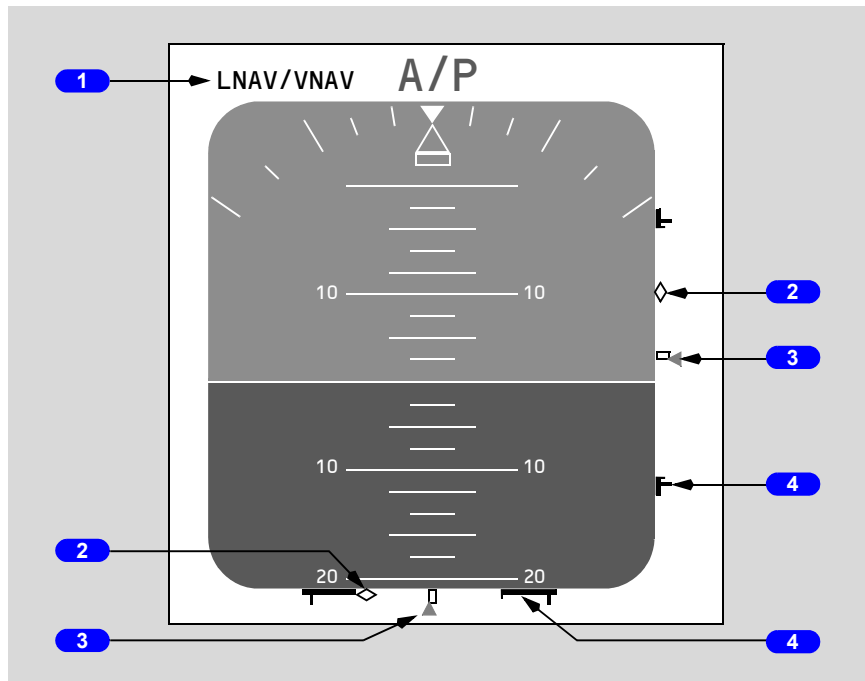
The display box is highlighted in white for 10 seconds when passing below 2500 feet.

Turns amber when below radio altitude minimums.

PFD Navigation Performance Indications

[Option – Enhanced RNP]

Navigation Performance Scales display when LNAV, VNAV, or TOGA are active modes or when LNAV is armed.



1 Navigation Source Reference

Displays the source of navigation performance for the navigation scales.

Possible combinations:

- LOC/VNAV – Localizer with VNAV deviation
- LNAV/ G/S – LNAV deviation with glideslope
- LNAV/VNAV – LNAV and VNAV deviation

2 Anticipation Cue (Ghost Pointer)

Represents the relative position of the path for the selected and activated approach.

3 Deviation Pointer

Pointer:

- unfilled magenta symbol when parked at deflection limit
- filled magenta when not parked at deflection limit
- indicates relative position from the annunciated navigation source
- flashes for ten seconds if pointer migrates into bar area for ten seconds.

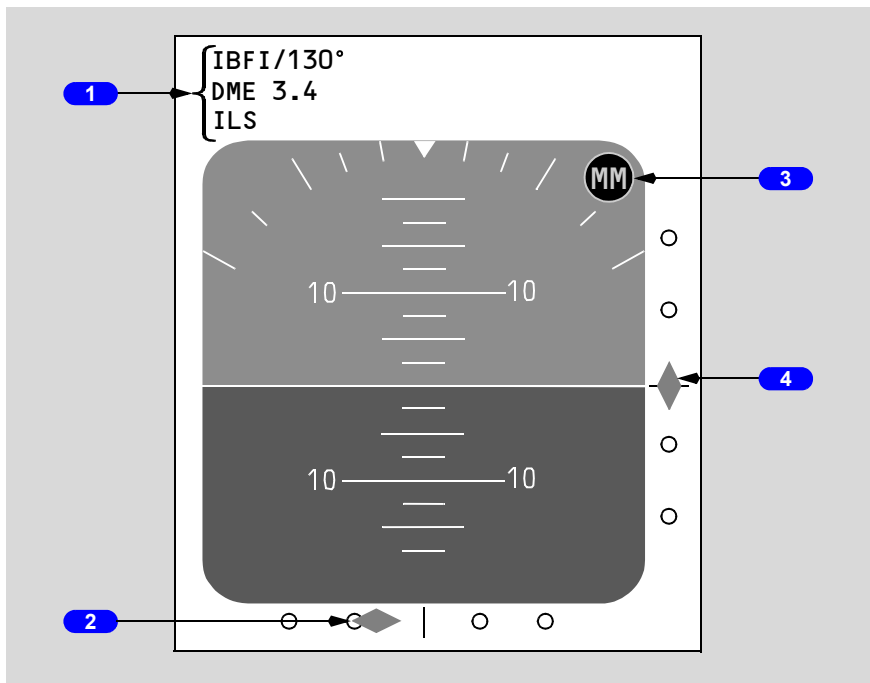
4 Deviation Scale

Deviation:

- bars represent difference between RNP and ANP
- area between bars indicates margin available to remain within RNP criteria
- if ANP equals RNP the white bars meet in the middle and turn amber indicating RNP operations can no longer be maintained and the NAV UNABLE RNP EICAS message is shown
- turns amber if pointer migrates into bar area for ten seconds.

PFD Instrument Landing System Indications

[Option – Enhanced RNP]



1 Approach Reference

[Option – Enhanced RNP]

Displays the selected ILS identifier or frequency, approach front course, ILS DME distance, and source annunciation.

If the tuned ILS frequencies disagree, the frequency turns amber with an amber horizontal line through it.

If the approach courses in the ILS receivers disagree, the course turns amber with an amber horizontal line through it.

2 Localizer Pointer and Scale

The localizer pointer:

- indicates localizer position relative to the airplane
- is in view when the localizer signal is received
- fills in solid when within 2 1/2 dots from the center.

The scale is in view after the frequency is tuned.

At low radio altitudes, with the autopilot or flight director engaged, the scale turns amber and the pointer flashes to indicate excessive localizer deviation.

At low altitudes, with LNAV engaged and LOC armed, the localizer scale turns amber and the pointer flashes if the localizer is not captured.

3 Marker Beacon Indication

The marker beacon indication appears flashing when over one of the marker beacon transmitters:

- IM – an airway or inner marker beacon
- MM – a middle marker beacon
- OM – an outer marker beacon.

The indication flashes in cadence with the beacon identifier.

4 Glideslope Pointer and Scale

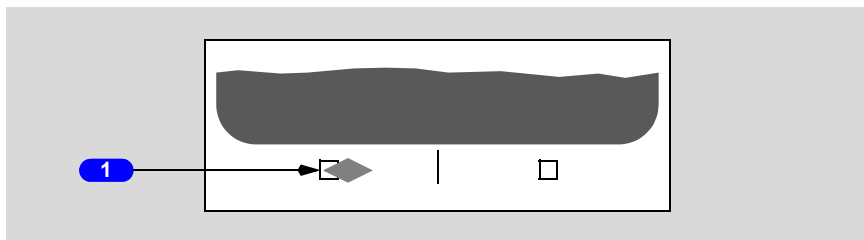
The glideslope pointer:

- indicates glideslope position relative to the airplane, and:
 - is in view when the glideslope signal is received
 - fills in solid when within 2 1/2 dots from the scale center.

The scale is in view after the frequency is tuned.

At low radio altitudes, with the autopilot or flight director engaged, the scale turns amber and the pointer flashes to indicate excessive glideslope deviation.

PFD Expanded Localizer Indications



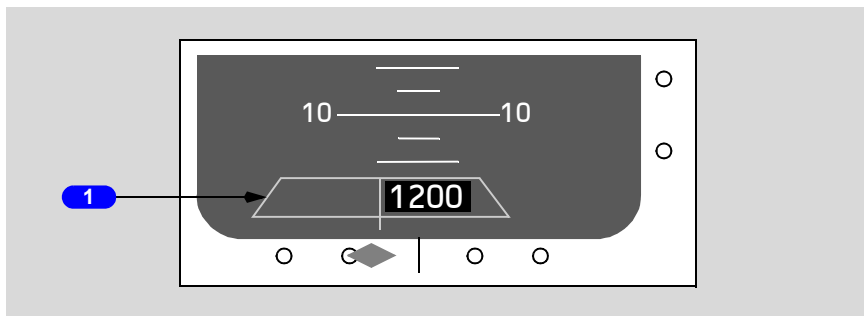
1 Expanded Localizer Scale

Displays when the autopilot or flight director is in LOC mode and the airplane is close to the runway center line. Provides a more sensitive display.

A rectangle equals 1/2 dot deviation.

PFD Rising Runway Indications

[Option – Rising Runway]



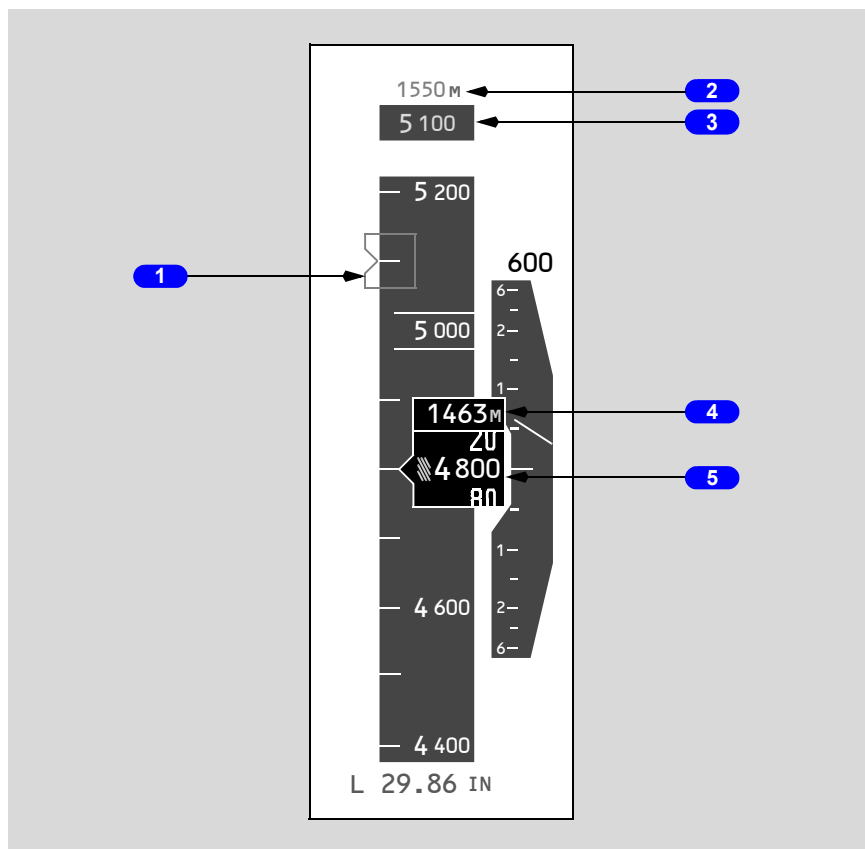
1 Rising Runway

Displayed below 2500 feet radio altitude when the localizer pointer is in view for both front and back courses.

Moves toward the airplane symbol below 200 feet radio altitude.

The stem of the rising runway symbol flashes when localizer deviations cause the diamond to flash.

PFD Altitude Indications



1 Selected Altitude Bug

Indicates the altitude set in the MCP altitude window.

When the selected altitude is off scale, the bug is parked at the top or bottom of the tape, with only one half the bug visible.

2 Selected Altitude – Meters

Displayed when MTRS is selected on the EFIS control panel MTRS switch.

Indicates selected altitude in meters (selected in feet in the MCP altitude window).

Displays in 10 meter increments.

3 Selected Altitude

Displays the altitude set in the MCP altitude window.

[Option – Altitude Alert 900–200 Foot Deviation (Options Not Shown: 800–200 Foot and 750–250 Foot Deviations)]

The selected altitude box is highlighted in white between 900 feet and 200 feet prior to reaching the selected altitude.

4 Current Altitude – Meters

Displayed when MTRS is selected on the EFIS control panel MTRS switch.

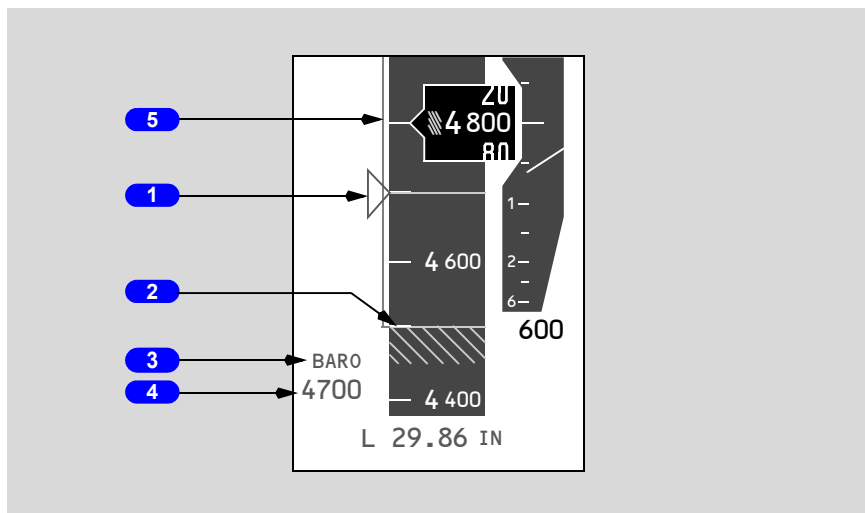
Displays altitude in meters.

5 Current Altitude

Indicates current ADIRS altitude.

PFD Landing Altitude/Minimums Indications

[Option – Landing Altitude Reference Bar]



1 BARO Minimums Pointer

When BARO minimums are displayed, the number is also represented as a pointer and line on the altitude scale.

Turns steady amber when the airplane descends below baro minimums.

2 Landing Altitude Indication

The crosshatched area indicates the FMC landing altitude for the destination runway or airport.

Indicates the landing altitude for the departure runway or airport until 400 NM or one-half the distance to the destination, whichever occurs first.

3 Minimums Reference

Displays BARO when the EFIS control panel MINS reference selector is set to BARO.

[Option – RA versions except round dial and upper right displays. Round dial and upper right displays do not show RADIO here]

Displays RADIO when the EFIS control panel MINS reference selector is set to RADIO (no corresponding line on the altitude scale).

Turns amber and flashes for 3 seconds when the airplane descends below selected minimum altitude.

4 Minimums

Displays the approach minimums altitude set using the EFIS control panel MINS selector:

- BARO minimums are feet MSL

[Option – RA versions except round dial and upper right displays. Round dial and upper right displays do not show RADIO here]

- RADIO minimums are radio altitude feet AGL.

Turns amber and flashes for 3 seconds when the airplane descends below selected minimum altitude.

5 Landing Altitude Reference Bar

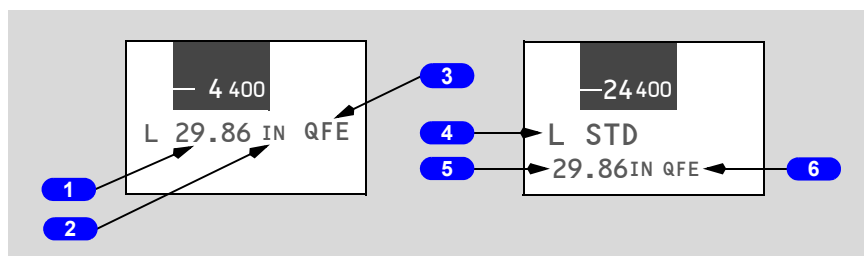
[Option]

Indicates the height above touchdown.

White bar – 500 to 1000 feet above landing altitude.

Amber bar – 0 to 500 feet above landing altitude.

PFD Barometric Indications



1 Barometric Setting

Indicates the barometric setting selected on the EFIS control panel barometric selector.

STD is displayed when STD is selected on the EFIS control panel barometric STD switch.

The display is boxed and changes to amber if a barometric setting is set, MCP altitude above transition altitude, and the altitude climbs above the transition altitude, or if STD is set, the MCP altitude is below transition altitude, and altitude descends below the transition flight level.

2 Barometric Reference

Indicates the barometric setting units selected on the EFIS control panel barometric reference selector:

- IN is inches of mercury
- HPA is Hectopascals.

3 QFE Altitude Reference

Indicates QFE altitude reference selected on the CDU APPROACH REF page.

When selected, QFE is boxed for 10 seconds.

The altitude tape is shaded green during QFE operation.

When QNH is selected, the green shading is removed; QNH is displayed for 10 seconds, then blanks.

4 Autopilot/Flight Director Barometric Source

L or R indicates that the left or right EFIS control panel is the barometric setting reference for the autopilot or flight director (the same indication is displayed on both PFDs).

Displayed when a flight director switch is ON or the autopilot is engaged.

- F/D – one turned on and one not on determines L or R
- F/D – both on – L is displayed
- A/P – first one pushed on determines L or R.

5 Preselected Barometric Setting

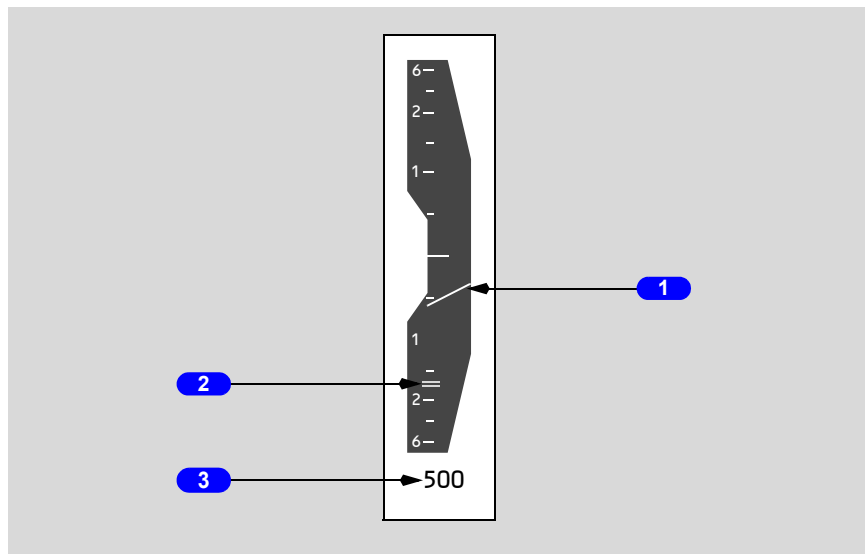
A barometric setting can be preselected when STD is displayed.

The preset barometric setting is selected on the EFIS control panel barometric selector and is displayed below STD.

6 QFE

When STD is selected, a small QFE appears when QFE is selected.

PFD Vertical Speed Indications



1 Vertical Speed Pointer

Indicates current vertical speed.

2 Selected Vertical Speed Bug

Indicates the speed selected in the MCP vertical speed window with the V/S pitch mode engaged.

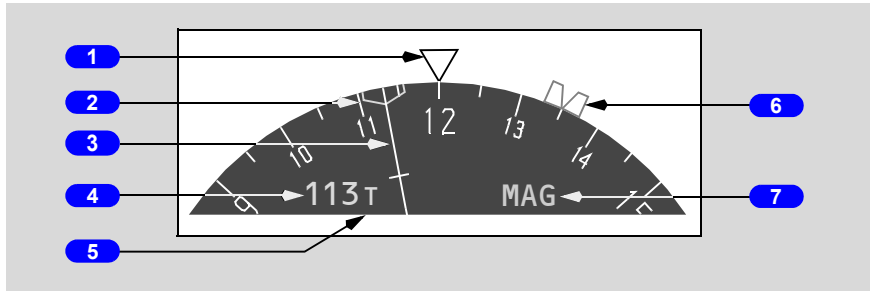
3 Vertical Speed

Displays vertical speed when greater than 400 feet per minute.

The display is located above the vertical speed indication when climbing and below when descending.

PFD Heading/Track Indications

Note: The selected track bug and selected heading bug are not displayed at the same time.



1 Current Heading Pointer

Indicates current heading.

2 Selected Track Bug (MCP Selection)

The selected track bug is displayed on the inside of the compass rose.

If selected track exceeds display range, the bug parks on the side of the compass rose in the direction of the shorter turn to the track.

3 Track Line

Indicates the current track.

4 Selected Heading/Track (MCP Selection)

Digital display of the selected heading or track bug.

5 Selected Heading/Track Reference (MCP Selection)

When HDG (heading) is selected, an H is displayed.

When TRK (track) is selected, a T is displayed.

6 Selected Heading Bug (MCP Selection)

The selected heading bug is displayed on the outside of the compass rose.

If selected heading exceeds display range, the bug parks on the side of the compass rose in the direction of the shorter turn to the heading.

7 Heading/Track Reference

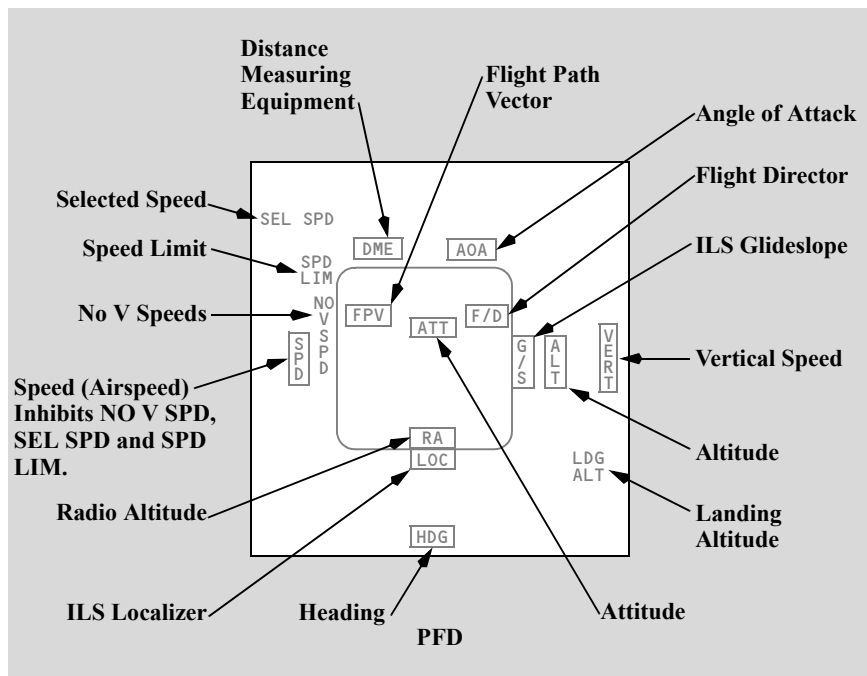
Displays the automatic or manually selected heading/track reference:

- MAG (magnetic north)
- TRU (true north).

PFD Failure Flags

Note: PFD failure flags replace the appropriate display to indicate source system failure, or lack of computed information.

[Option – Basic, Lower Center RA Indication plus angle of attack]



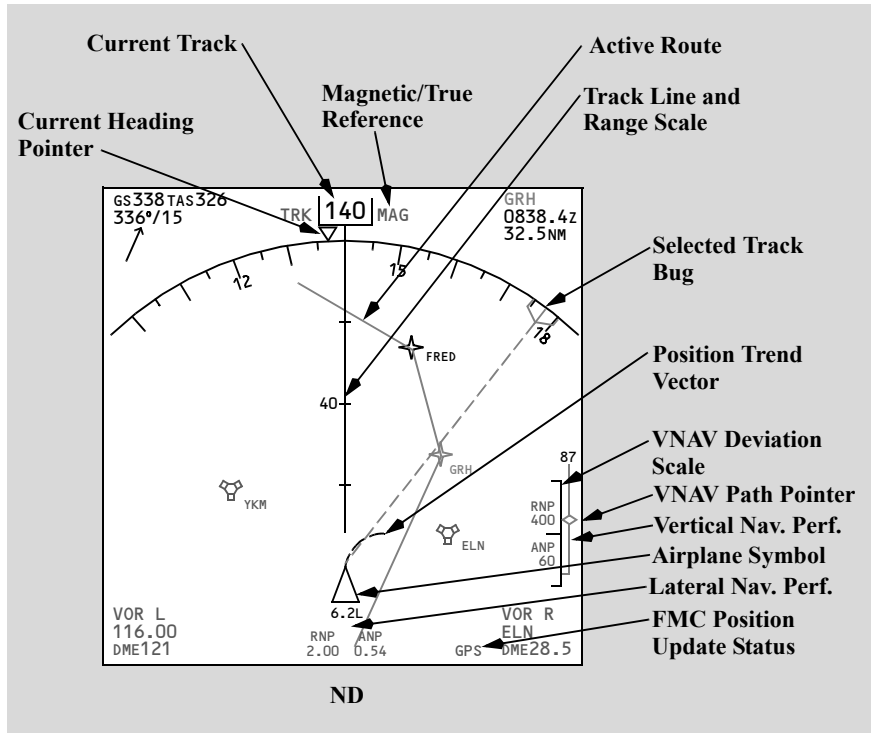
Navigation Display (ND)

Note: Refer to the Navigation Display section of this chapter for a detailed explanation of the ND symbology shown on the following pages.

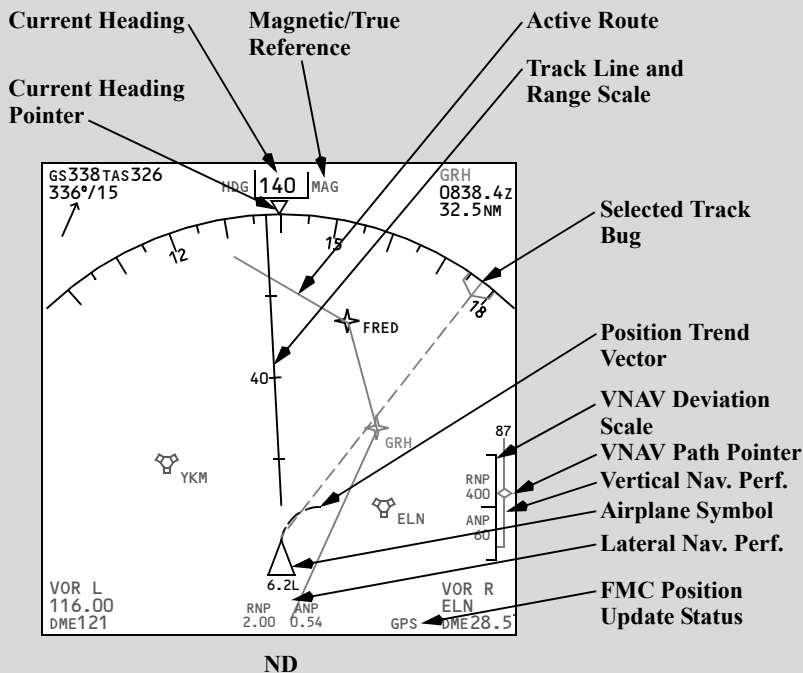
ND Map Mode

Expanded Map Mode

[Option – Track-Up Display, Nav Perf]

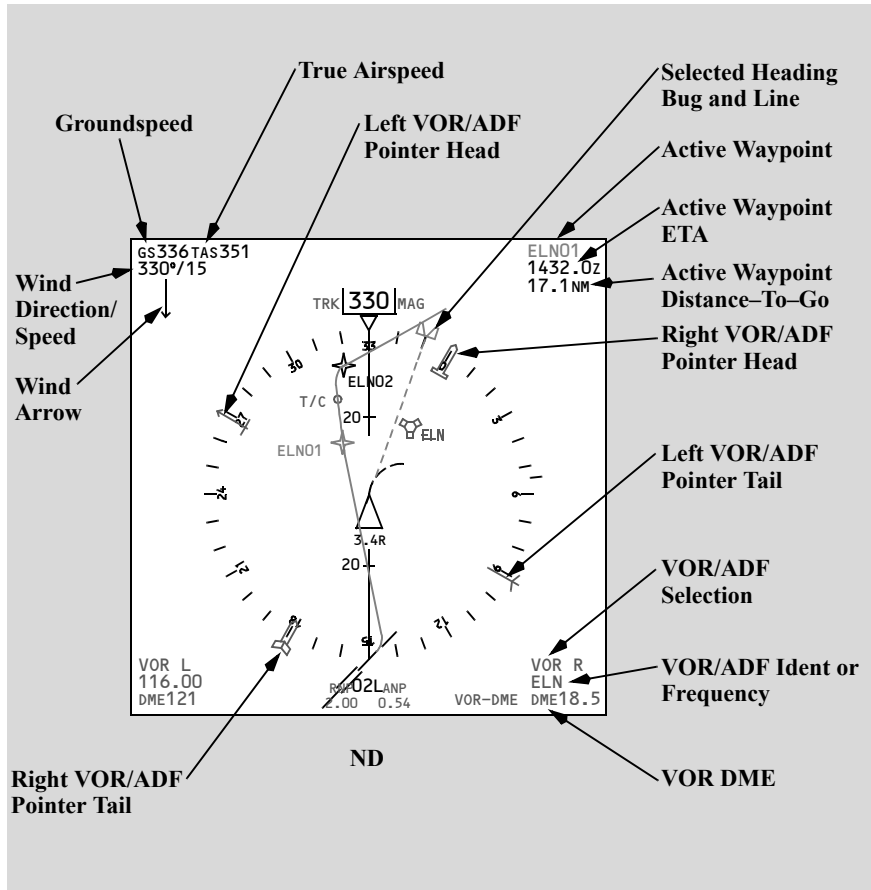


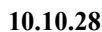
[Option – Heading-up Display, Nav Perf]

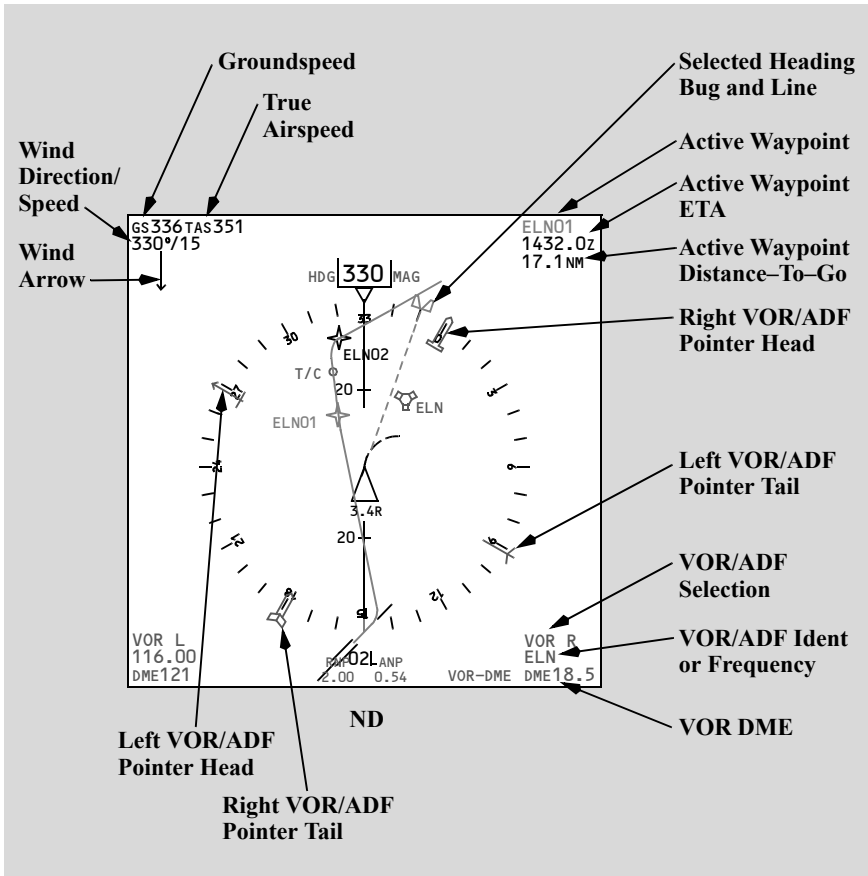
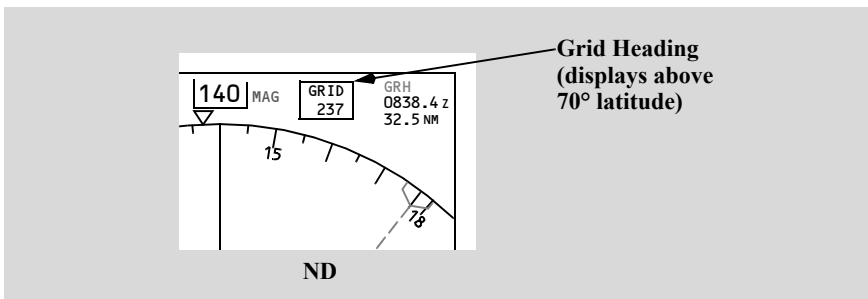


Centered Map Mode

[Option – Track-up Display, Nav Perf]

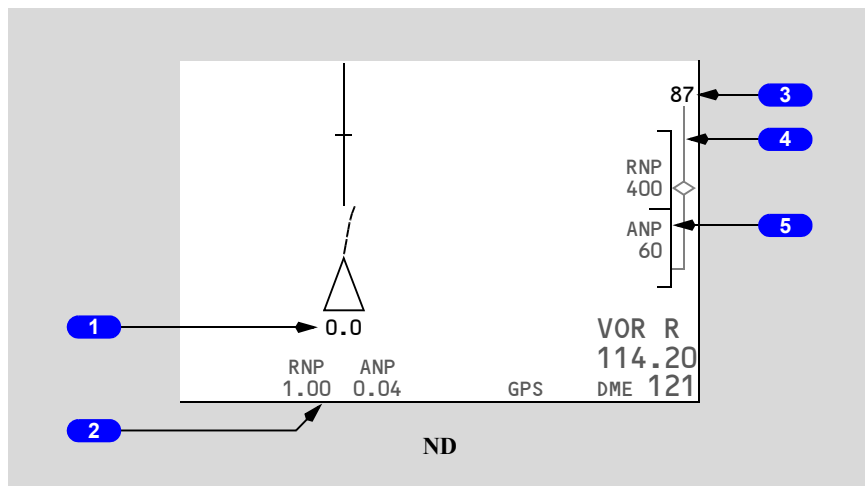




[Option – Heading-up Display, Nav Perf]**ND Grid Heading Display****[Option – Grid Heading]**

ND Navigation Performance Indications

[Option – Enhanced RNP / ANP]



1 Lateral Path Deviation

A digital value is displayed below the airplane symbol to show the lateral deviation (in NM) when an active path is defined. The numeric value is followed by an R or L to indicate the airplane position relative to the path.

2 Lateral RNP / ANP

Digital display (in NM) of the RNP and ANP. The RNP can be changed on the CDU RNP PROGRESS page 4.

Normally green, changes to amber when ANP exceeds RNP.

3 Vertical Path Deviation

Digital vertical path deviation (in feet) displays when value exceeds 20 feet.

4 Vertical Path Deviation Band

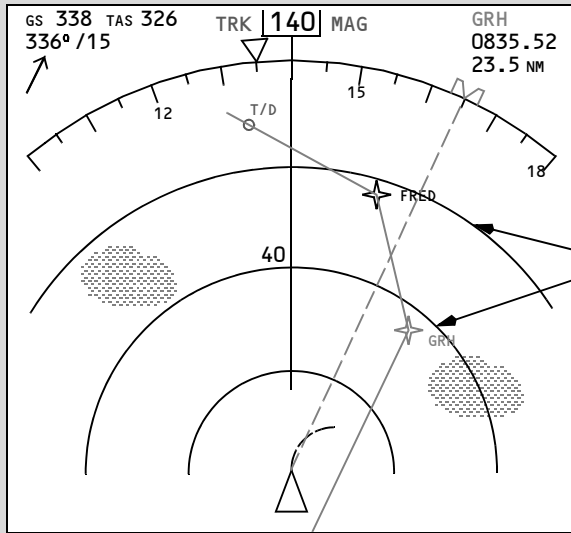
Band is centered on VNAV path pointer and represents current vertical RNP.

5 Vertical RNP /ANP

Digital vertical deviation values (in feet). RNP can be changed on the CDU RNP PROGRESS page 4.

ND Weather Radar System Display Indications

[Option – Range Arcs]

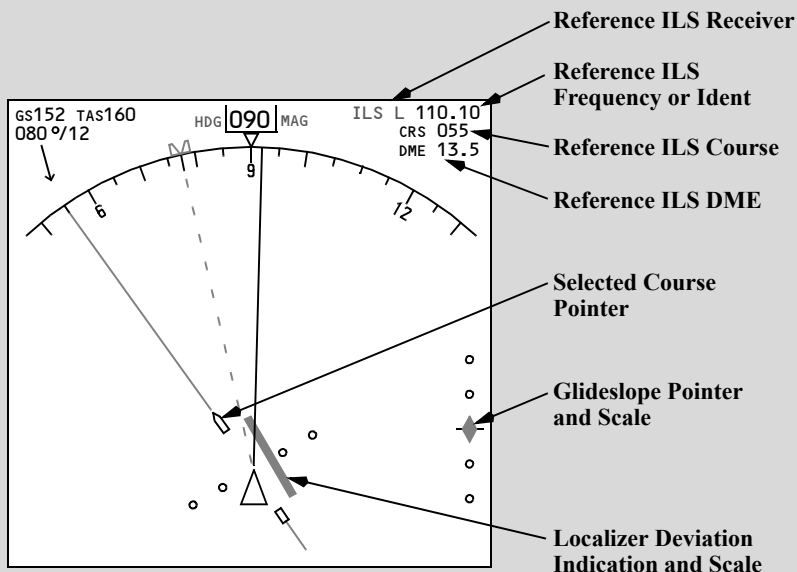


ND

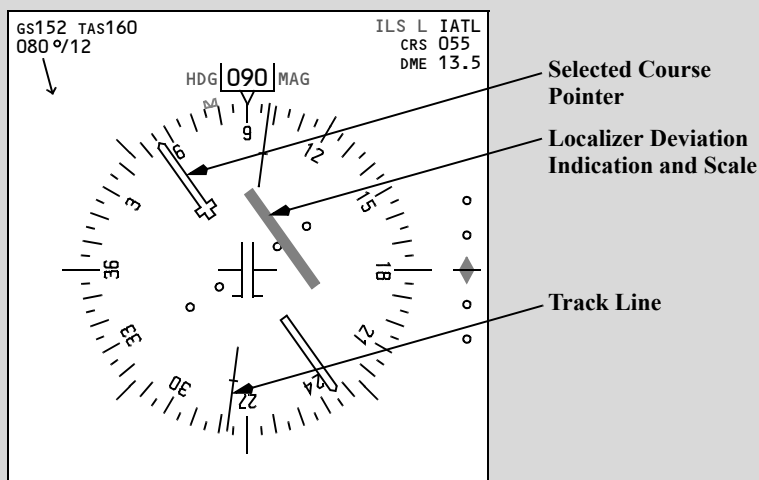
1 TCAS/Weather Radar Range Arcs

Three range arcs in place of the range scale ticks on map when TCAS, weather radar, or terrain is selected.

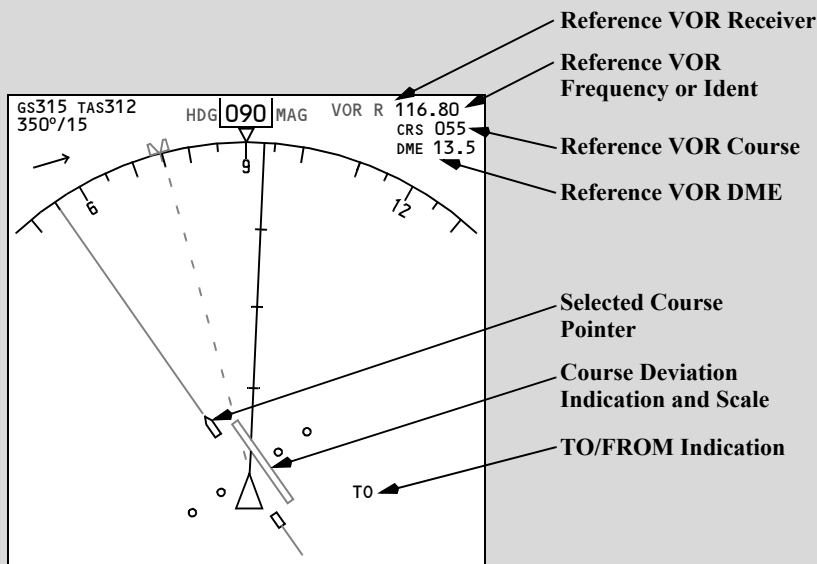
ND Approach Mode



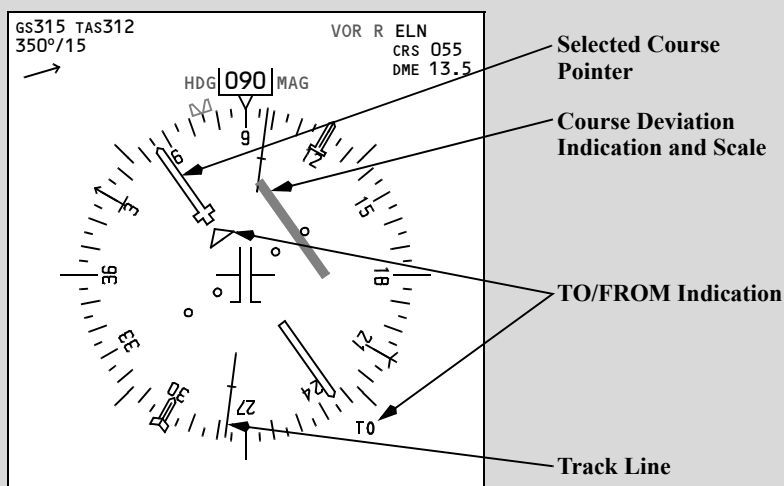
**ND
EXPANDED APPROACH MODE**



CENTERED APPROACH MODE

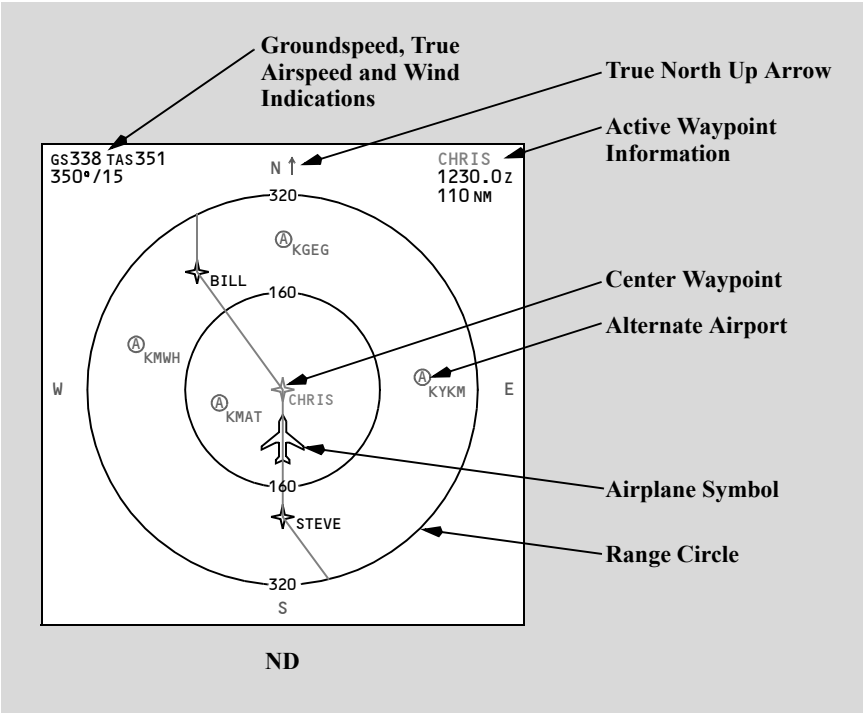
ND VOR Mode

**ND
EXPANDED VOR MODE**



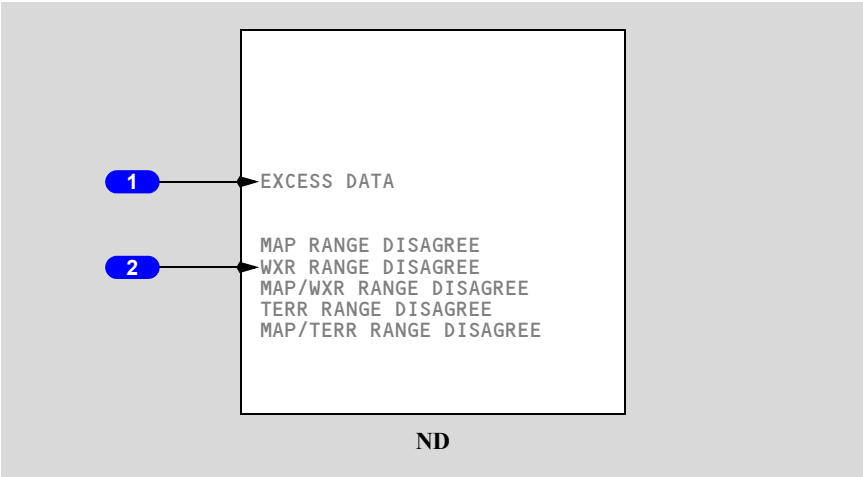
CENTERED VOR MODE

ND Plan Mode



ND Failure Indications and Flags

ND Failure Messages



1 Excess Data

The amount of map information sent to the primary display system is too great to display.

2 MAP/WXR Range Disagree

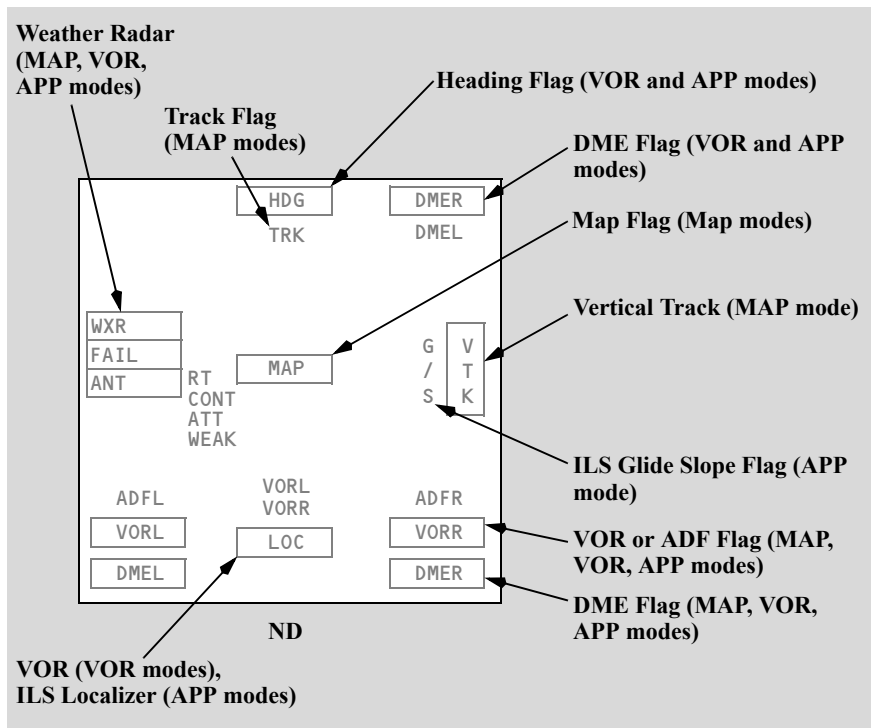
The selected range and range of display information disagree.

Map information is removed.

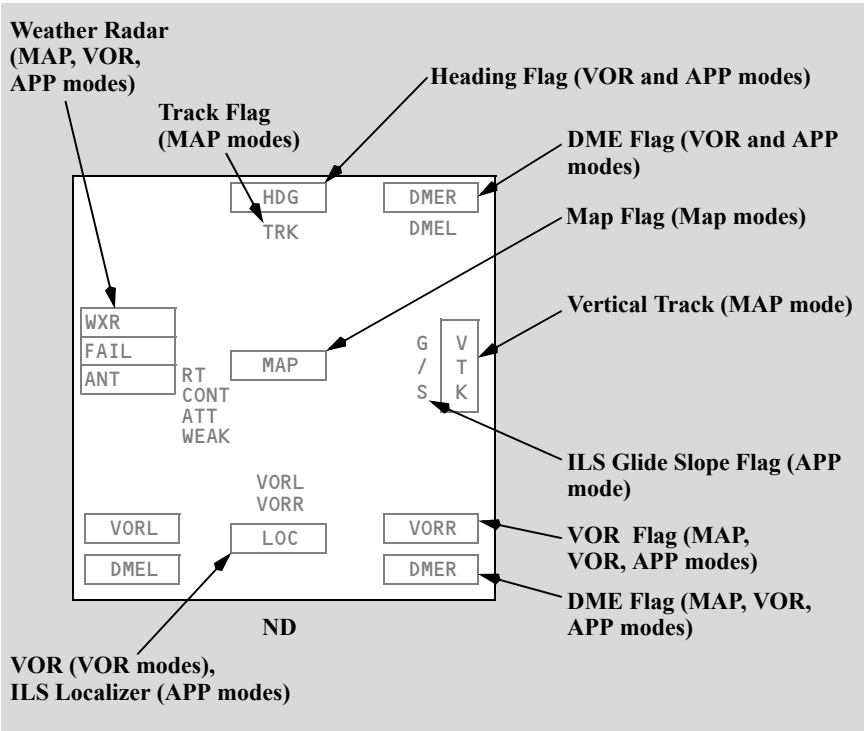
ND Failure Flags

Dashes replace numbers if there is no computed information. Failure flags replace symbols or failure messages are displayed, as appropriate. Flag location varies, depending on the ND mode selected.

[Option – Track-Up Display, Heading-Up Similar]

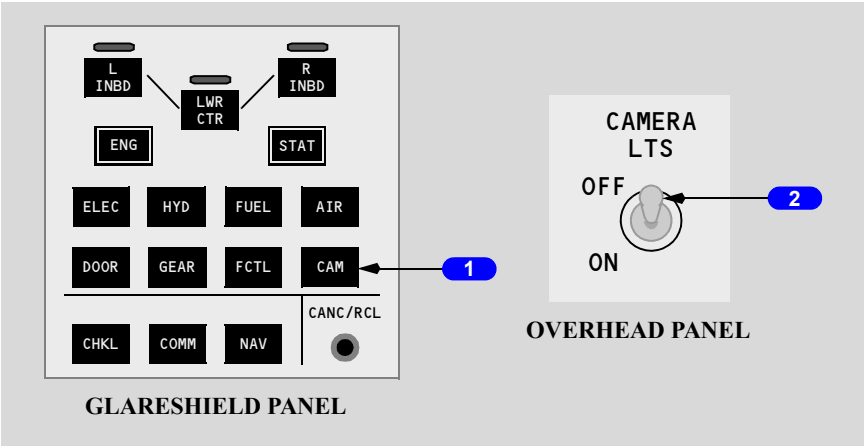


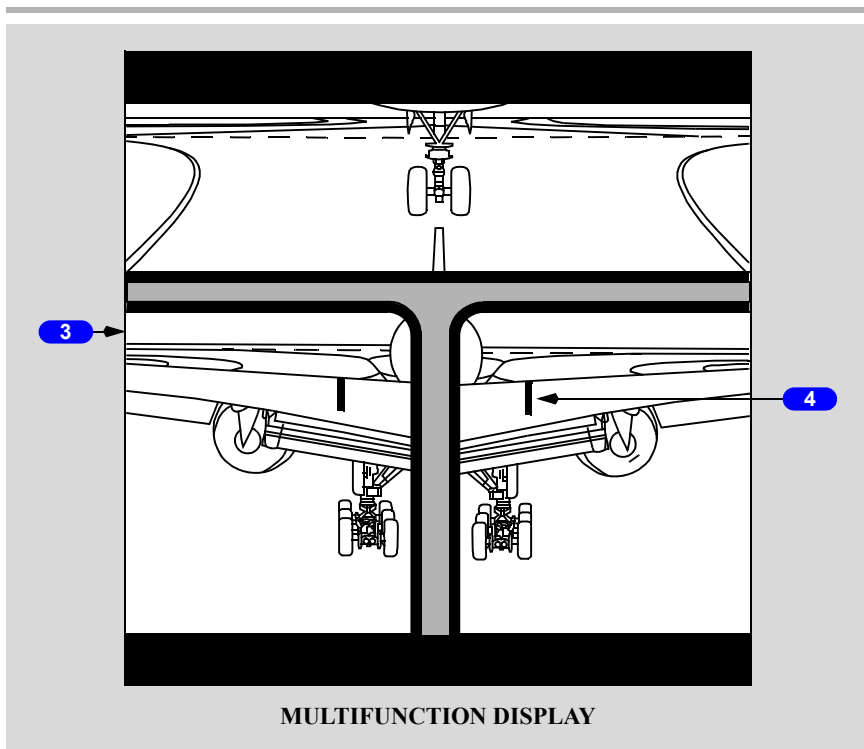
[Option – Track-Up Display, Heading-Up Similar]



Ground Maneuver Camera System

[777-300, 777-300ER]



**1 Camera (CAM) Display Switch**

Push – displays the main and nose landing gear on the selected MFD.

2 CAMERA LTS Switch

ON – turns on lights to illuminate the main and nose landing gear. The nose gear must be down and locked, and the BEACON light switch must be ON for the camera lights to operate.

3 Ground Maneuver Camera System Display

The main and nose landing gear are displayed on the selected MFD when the CAM display switch is pushed.

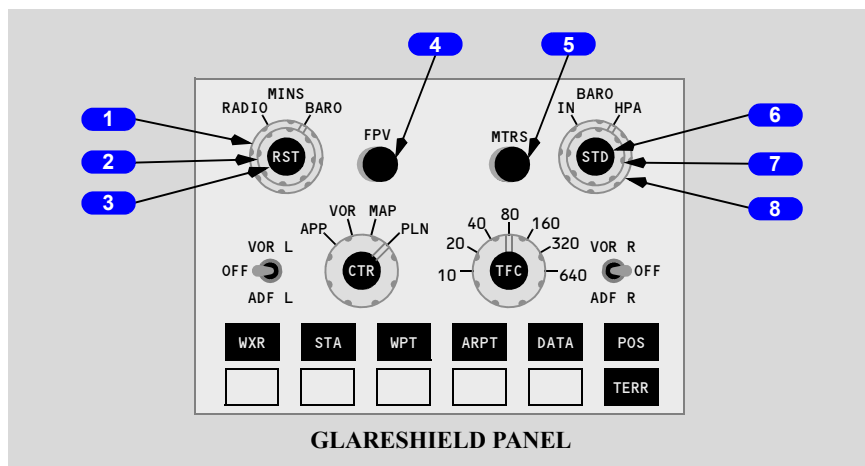
4 Main Landing Gear Location Stripes

The main landing gear location stripes, located on the tops of the wings, are directly above the outside of the main gear wheels. The stripes assist the pilot in locating the main gear wheels in adverse lighting conditions.

EFIS Control Panels

The left EFIS control panel controls the left PFD and ND. The right EFIS control panel controls the right PFD and ND.

EFIS Control Panel PFD Controls



1 Minimums (MINS) Reference Selector (outer)

RADIO – selects radio altitude as the PFD minimums reference.

BARO – selects barometric altitude as the PFD minimums reference.

2 Minimums (MINS) Selector (middle)

Rotate (slew)– adjusts the PFD radio or baro minimums altitude.

3 Minimums Reset (MINS RST) Switch (inner)

Push –

- resets the PFD minimums alert display
- blanks the minimums display when green.

4 Flight Path Vector (FPV) Switch

Push – displays the PFD flight path vector.

5 Meters (MTRS) Switch

Push – displays PFD altitude meters indications.

6 Barometric Standard (BARO STD) Switch (inner)

Push –

- selects the standard barometric setting (29.92 inches Hg/1013 HPA) for the PFD barometric reference
- if STD is displayed, selects the preselected barometric setting
- if no preselected barometric setting is displayed, displays the last value before STD was selected.

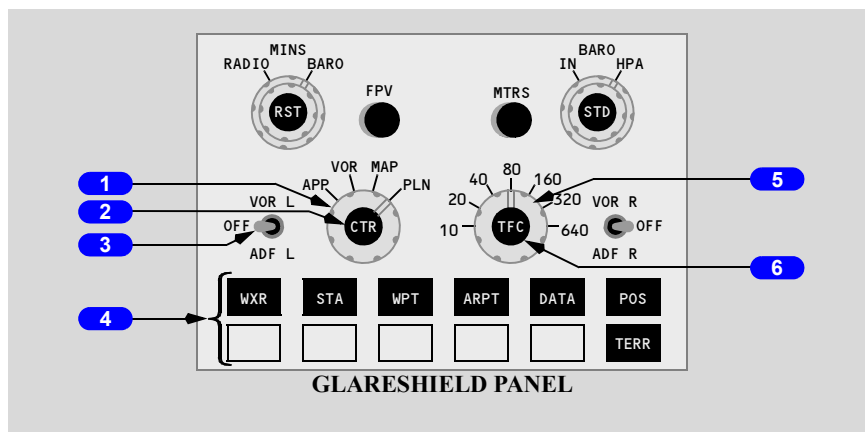
7 Barometric (BARO) Selector (middle)

Rotate (slew) – adjusts the PFD barometric reference.

8 Barometric (BARO) Reference Selector (outer)

IN – selects inches of mercury as the PFD barometric reference.

HPA – selects Hectopascals as the PFD barometric reference.

EFIS Control Panel ND Controls**1 ND Mode Selector (outer)**

Selects the desired ND map display.

APP –

- displays localizer and glideslope information in heading-up format
- displays reference ILS receiver, ILS frequency or identification, course, and DME
- weather radar and TCAS are not displayed in CTR APP mode.

VOR –

- displays VOR navigation information in heading–up format
- displays reference VOR receiver, VOR frequency or identification, course, DME, and TO/FROM indication
- weather radar and TCAS are not displayed in CTR VOR mode.

MAP –

- displays FMC–generated route and map information, airplane position, heading, and track
- displays waypoints, including the active waypoint, within the selected range
- displays VNAV path deviation.

PLN –

- displays a nonmoving, true north–up, route depiction
- the airplane symbol represents actual airplane position
- allows route step–through using the CDU legs page
- weather radar and TCAS are not displayed in PLN mode.

2 ND Center (CTR) Switch (inner)

Push –

- displays the full compass rose (centered) for APP, VOR, and MAP modes
- subsequent pushes alternate between expanded and centered displays.

3 VOR/ADF Switches

Displays VOR or ADF information on the respective ND.

VOR – displays the VOR pointer, VOR frequency or identification and associated DME information in all modes except PLAN.

OFF – removes VOR and ADF displays.

ADF – displays the ADF pointer and ADF frequency or identification in all modes except PLAN.

4 Map Switches

The map switches:

- select detailed ND information displays
- displays can be selected simultaneously
- second push removes the information.

WXR (weather radar) – turns the weather radar on and off, and displays weather radar information (refer to Chapter 11, Flight Management, Navigation). Also displays range information when in the expanded APP or VOR modes.

STA (station) –

- displays high and low altitude navigation aids, if the ND range selector is in the 10, 20 or 40 NM range
- displays high altitude navigation aids, if the ND range selector is in the 80, 160, 320, or 640 NM range.

WPT (waypoint) – displays waypoints, if the ND range selector is in the 10, 20 or 40 NM range.

ARPT (airport) – displays airports on all ranges.

DATA – displays the FMC estimated time of arrival, altitude at each waypoint, and altitude constraints at each waypoint.

POS (Position) –

- displays ADIRU and GPS positions
- displays VOR raw data radials extended from the nose of the airplane to the stations displayed on the CDU NAV RAD page.

TERR (terrain) – displays terrain data. (Refer to Chapter 15, Warning Systems.)

5 ND Range Selector (outer)

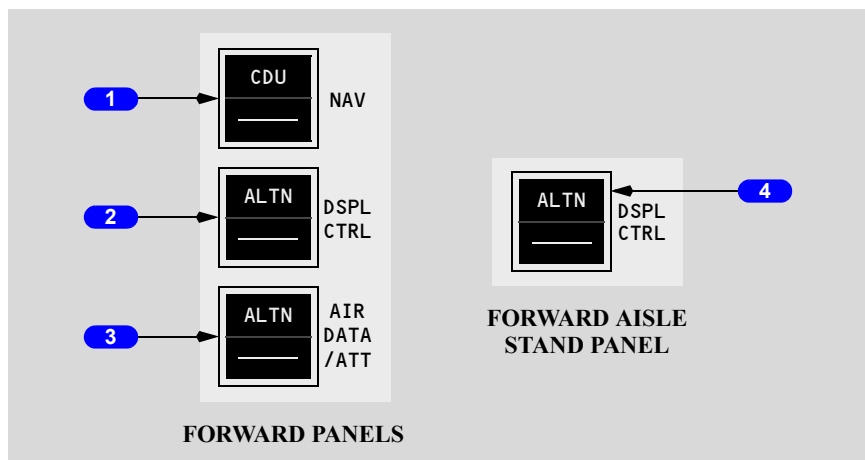
Selects the desired ND nautical mile range scale.

6 ND Traffic (TFC) Switch (inner)

Push – displays TCAS ND information. (Refer to Chapter 15, Warning Systems.) Also displays range information when in the expanded APP or VOR modes.

Instrument Source Select Panels

The instrument source switches are provided for use if a display-related failure is not detected by automatic system monitors. Normally, the display system automatically reconfigures for failures without the pilot having to use these switches.



1 Navigation (NAV) Source Switch

Off – normal position (CDU not visible, switch out):

- with the FMC selector in AUTO, the active FMC provides the information to generate the ND map
- if both FMCs fail, the CDU provides navigation data.

CDU – non-normal position (CDU visible, switch in). The selected CDU generates the ND map. Normally, the sources are:

- left ND map – left CDU
- right ND map – right CDU.

2 Display Control (DSPL CTRL) Source Switch

Off – normal position (ALTN not visible, switch out):

- automatically selects display processing channels for the left outboard and inboard, or right outboard and inboard display pairs
- reconfigures display processing channels as required for display unit or processing channel failures.

ALTN – non-normal position (ALTN visible, switch in). An alternate display processing channel is selected to replace the current display processing channel.

3 Air Data / Attitude (AIR DATA/ATT) Source Switch

Off – normal position (ALTN not visible, switch out):

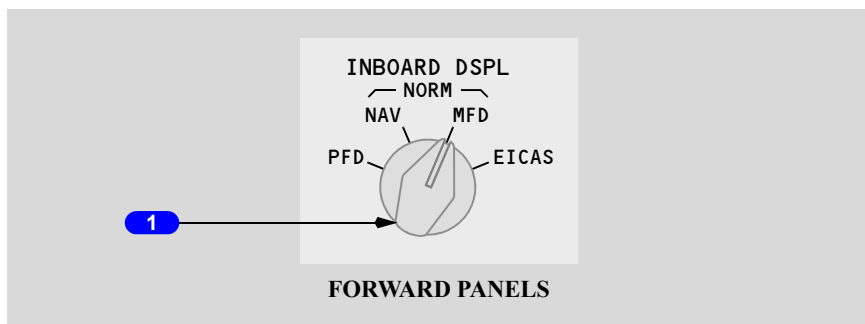
- the ADIRU provides air data and attitude information to the PFD and ND
- Alternate sources or the SAARU are automatically selected to replace ADIRU air data or attitude, as required.

ALTN – non-normal position (ALTN visible, switch in). The PFD and ND alternate air data/attitude source is selected as follows:

- air data (captain): SAARU single channel
- air data (first officer): ADIRU single channel
- attitude (captain and first officer): SAARU.

4 Center Display Control (DSPL CTRL) Source Switch

Same as the display control source switches for the left and right inboard and outboard display units, except this switch controls the upper center and lower center display units.

Heading Reference and Inboard Displays**Inboard Display Controls****1 INBOARD Display (DSPL) Selector**

Selects what is displayed on each inboard display unit.

PFD – displays the PFD, blanks the PFD on the outboard display unit, and inhibits selections made from the display select panel.

NAV – displays the ND and inhibits selections made from the display select panel.

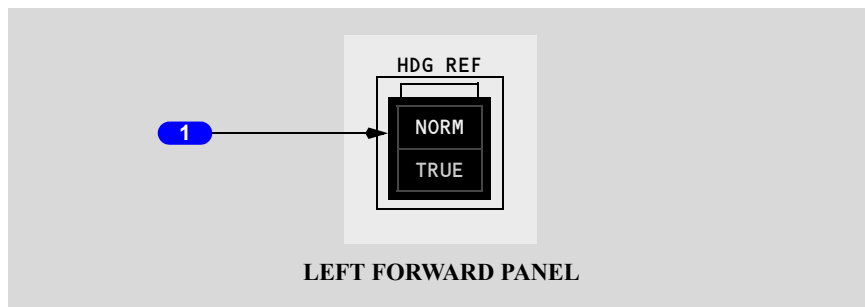
MFD – displays the selection made on the display select panel.

EICAS –

- displays EICAS
- inhibits most selections made from the display select panel (limited ENG, FUEL, and AIR displays can be selected)
- blanks the upper center display unit.

Note: The PFD automatically appears on an inboard display unit if the adjacent outboard display unit fails, regardless of switch position.

Heading Reference Controls



1 Heading Reference (HDG REF) Switch

Pushing alternately selects the heading reference for the PFDs, NDs, AFDS, and FMCs.

NORM –

- normally references magnetic north
- automatically references true north when north of 82°N or south of 82°S latitude or within the vicinity of the magnetic poles (PFDs, NDs, and FMCs)
- provides no reference for AFDS roll modes other than LNAV when north of 82°N or south of 82°S latitude or in the vicinity of the magnetic poles.

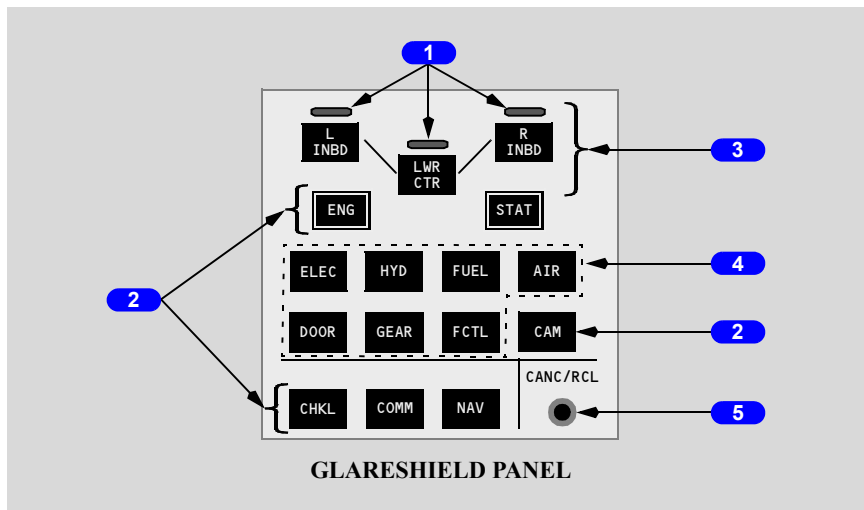
TRUE – references true north regardless of latitude.

When the AFDS roll mode is HDG SEL, switching the heading reference switch from NORM to TRUE or TRUE to NORM engages the HDG HOLD mode.

When the AFDS roll mode is TRK SEL, switching the heading reference switch from NORM to TRUE or TRUE to NORM engages the TRK HOLD mode.

Display Select Panel

[Option – 777-300, 777-300ER Ground Maneuver Camera System Switch]



1 Display Lights

Illuminates to show the display unit the display select panel controls.

2 Display Switches

Pushing the switch displays the associated display. Pushing the same switch a second time blanks the display or (left and right inboard display units) redisplay the ND if there is only one page of messages. If there are more than one page of messages, pushing STAT pages through the messages.

ENG – secondary engine EICAS (Ch. 7).

STAT – status page:

- hydraulic system indications (Ch. 13)
- APU indications (Ch. 7)
- oxygen system indications (Ch. 1)
- status messages for dispatch determination (Ch. 15).

CHKL – checklist (this chapter).

COMM – communications (Ch. 5).

NAV – navigation display (this chapter).

[777-300, 777-300ER]

CAM – ground maneuver camera system (this chapter).

3 Multifunction Display (MFD) Switches

Selects the active MFD (left inboard, lower center, or right inboard display unit) for display selection.

The appropriate left or right INBOARD DISPLAY selector must be in the MFD or EICAS position. The other display select panel switches determine what is displayed on the selected MFD.

4 Synoptic Switches

Pushing the switch displays the associated synoptic. Synoptics present a simplified view of system status as an aid for crew situational awareness. Pushing the same switch a second time blanks the display or (left and right inboard display units) redisplay the ND.

ELEC – electrical system (Ch. 6).

HYD – hydraulic system (Ch. 13).

FUEL – fuel system (Ch. 12).

AIR – air systems (Ch. 2).

DOOR – doors (Ch. 1).

GEAR – landing gear and brake systems (Ch. 14).

FCTL – flight control system (Ch. 9).

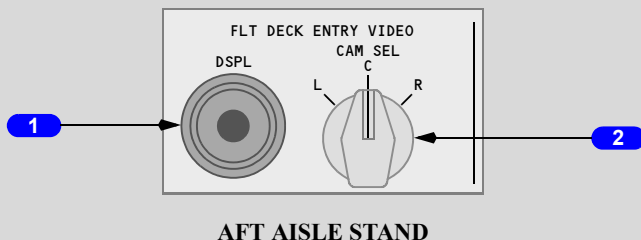
5 Cancel/Recall (CANC/RCL) Switch

Refer to Warning Systems, Chapter 15.

Flight Deck Entry Video Surveillance System (FDEVSS)

[Option – Flight Deck Security Video on MFD]

Flight Deck Entry Video Panel



1 Display (DSPL) Switch

Push – displays surveillance video on active MFD.

If using an INBD display unit, the appropriate left or right INBOARD DSPL selector must be in the MFD position.

Second push – cancels display of surveillance video on active MFD.

2 Camera (CAM) Selector (SEL)

Selects camera location for display on selected MFD.

L – displays view of door 1L & flight deck door area.

C – displays view from flight deck door looking aft.

R – displays view from door 1R looking toward cross-aisle.

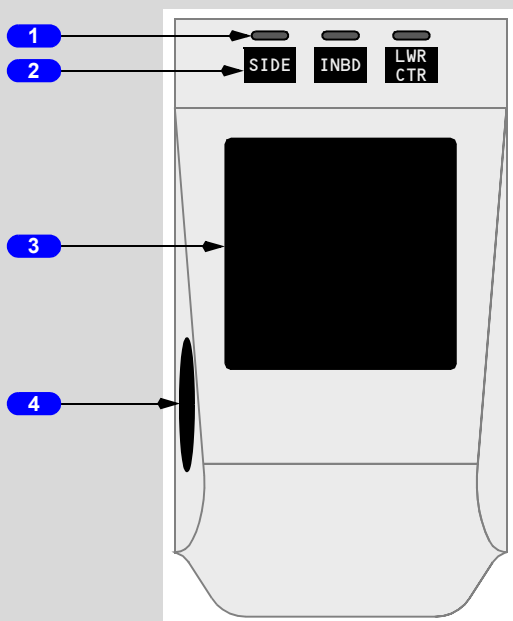
Cursor Control Device (CCD)

[Option – Side Display]

The left CCD controls the left inboard, left side, and lower center display unit cursor position and operation.

The right CCD controls the right inboard, right side, and lower center display unit cursor position and operation.

The left CCD is shown; the right CCD is similar, except the cursor select, SIDE, and LWR CTR switches are located on the opposite side of the CCD.



CONTROL STAND

1 Cursor Location Lights

The associated annunciator light illuminates to indicate which display unit is selected.

2 Cursor Location Switches

Selects the display unit where the cursor appears (side, inboard, or lower center display) and automatically deselects the previous display unit.

3 Touch Pad

Finger movement on the touch pad moves the cursor on the selected display. Lifting the finger off the pad and putting it back down in a different location (except the corner areas) does not move the cursor. The cursor only moves when the finger is moved on the touch pad surface.

Corner areas – placing a finger in one of the four corners puts the cursor in that respective corner of the screen. Moving the cursor into a corner region without lifting the finger from the pad does not have this effect.

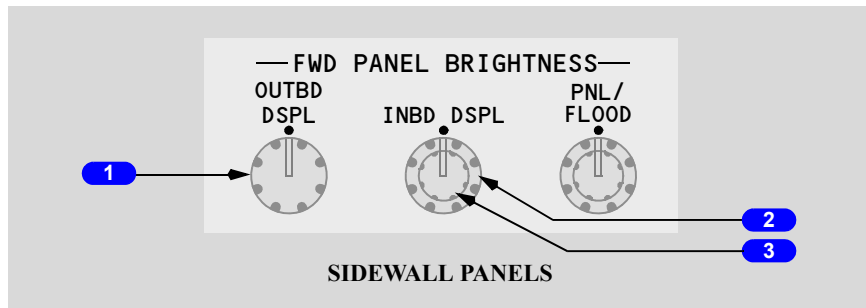
4 Cursor Select Switch

Push – activates the area of the screen that the cursor is currently in, such as a menu item or command button. The area is highlighted by a white border to indicate it can be selected.

The switch is used to select menus, checklists, checklist steps, and other functions.

Display Brightness Controls**Forward Panel Brightness Controls**

The left panel is shown.

**1 Outboard Display (OUTBD DSPL) Brightness Control**

Rotate – adjusts the brightness of the outboard display unit.

2 Inboard Display (INBD DSPL) Brightness Control (outer)

Rotate – adjusts the brightness of the inboard display unit.

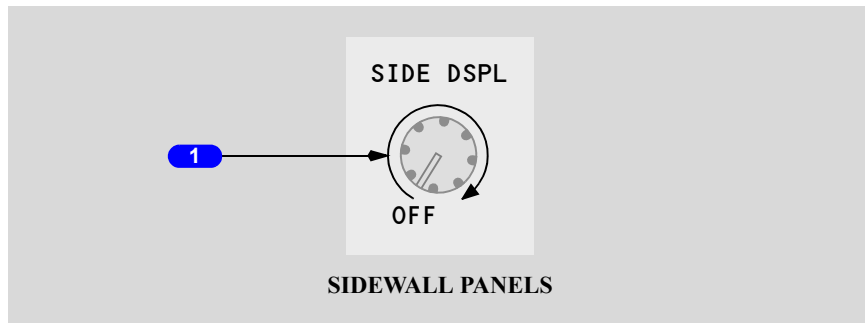
3 Inboard Display (INBD DSPL) Brightness Control (inner)

Rotate – adjusts weather radar, terrain display, or ground maneuver camera display brightness on the inboard display unit.

Only one function can be displayed at a time.

Side Display Brightness Controls

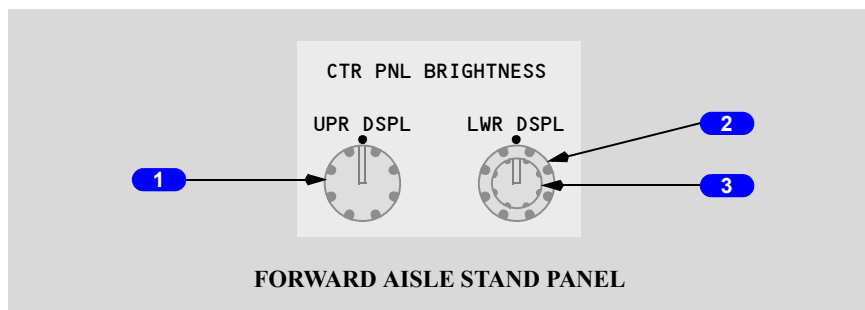
[Option]



1 SIDE Display (DSPL) Brightness Control

Rotate – adjusts the brightness of the side display unit.

Center Panel Brightness Controls



1 Upper Display (UPR DSPL) Brightness Control

Rotate – adjusts the brightness of the upper center display unit.

2 Lower Display (LWR DSPL) Brightness Control (outer)

Rotate – adjusts the brightness of the lower center display unit.

3 Lower Display (LWR DSPL) Brightness Control (inner)

Rotate – adjusts weather radar, terrain display, or ground maneuver camera brightness on the lower center display unit.

Only one function can be displayed at a time.

Standby Flight Instruments

The standby flight instruments include the:

[ISFD]

- integrated standby flight display
- standby magnetic compass

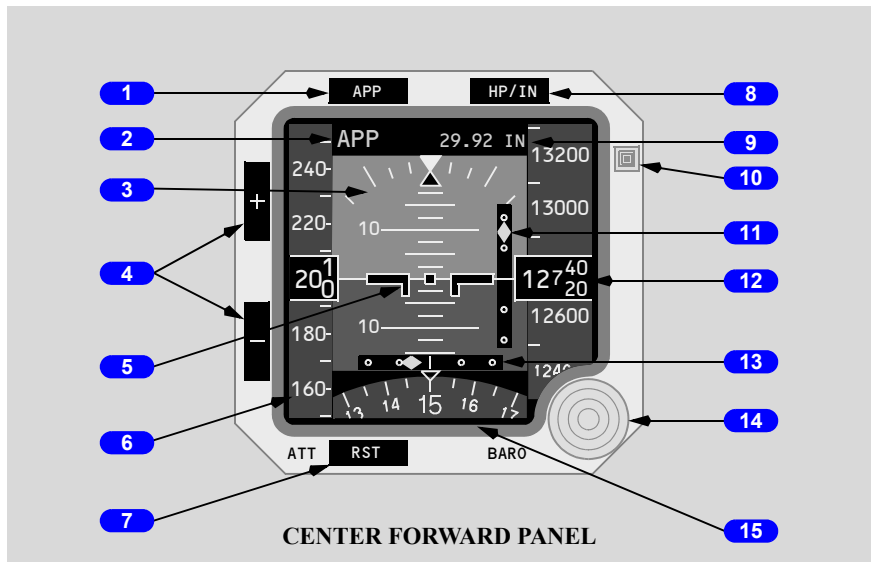
[non ISFD]

- standby magnetic compass
- standby attitude indicator
- standby airspeed indicator
- standby altimeter.

The standby attitude, airspeed, and altimeter indicators are small flat panel liquid crystal display units.

Integrated Standby Flight Display (ISFD)

Provides an independent source of attitude, airspeed, and altitude information.



1 Approach (APP) Switch

Push -

- when blank, selects APP
- when APP displayed, selects BCRS
- when BCRS displayed, blanks.

2 Approach Mode Annunciation

Indicates approach mode selected.

Blank - no approach deviation data displayed.

APP - ILS localizer and glideslope deviation data displayed.

BCRS (back course) - reverses sensing for localizer pointer during back course approaches.

3 Attitude Display

Displays airplane attitude.

Indicates bank in reference to the bank scale.

Indicates the horizon relative to the airplane symbol.

Beyond 30 degrees pitch, large red arrowheads (V-shaped) indicate the attitude has become excessive and the direction to the horizon line.

4 Display Brightness Switches

Push -

- + increases display brightness
- - decreases display brightness.

5 Airplane Symbol

Indicates airplane position with reference to the horizon.

6 Airspeed Indications

Indicates airspeed when above 30 knots.

7 Attitude Reset (ATT RST) Switch

Push and hold at least two seconds -

- aligns horizon with the airplane symbol
- reset takes approximately ten seconds
- starts new initialization sequence if previous attempt failed (ground only).

8 Hectopascal/Inch (HP/IN) Switch

Push - changes units of barometric reference.

9 Barometric Setting

Indicates the barometric setting selected with the barometric selector.

STD is displayed when selected with the barometric selector.

10 Ambient Light Sensor

Automatically adjusts display intensity for ambient lighting condition.

11 Glideslope Pointer and Scale

The glideslope pointer indicates glideslope position relative to the airplane -

- the pointer is in view when the glideslope signal is received
- the scale is in view when the APP mode is selected
- the pointer and scale are removed when the BCRS mode is selected.

12 Current Altitude**13 Localizer Pointer and Deviation Scale**

The localizer pointer indicates localizer position relative to the airplane -

- the pointer is in view when the localizer signal is received
- the scale is in view when either the APP or BCRS mode is selected.

14 Barometric Selector (BARO)

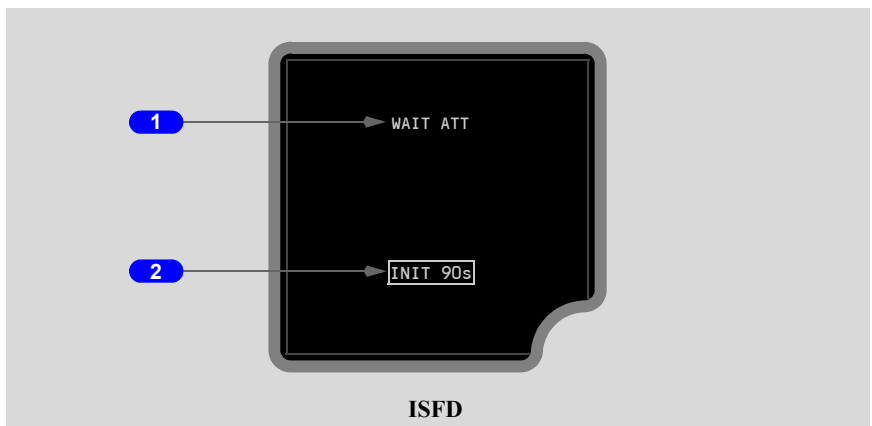
Rotate - changes barometric setting.

Push -

- selects standard barometric setting (29.92 inches Hg/1013 HPA)
- if STD displayed, selects the preselected barometric setting.

15 Heading Indication

Displays airplane heading.

ISFD Messages**1 Attitude Messages**

Indicates attitude display status.

ATT:RST (amber) - attitude must be reset using the attitude reset switch.

ATT 10s (amber) - 10 second attitude realignment in progress.

WAIT ATT (amber) - indicates temporary self correcting loss of attitude.

2 Initialization message

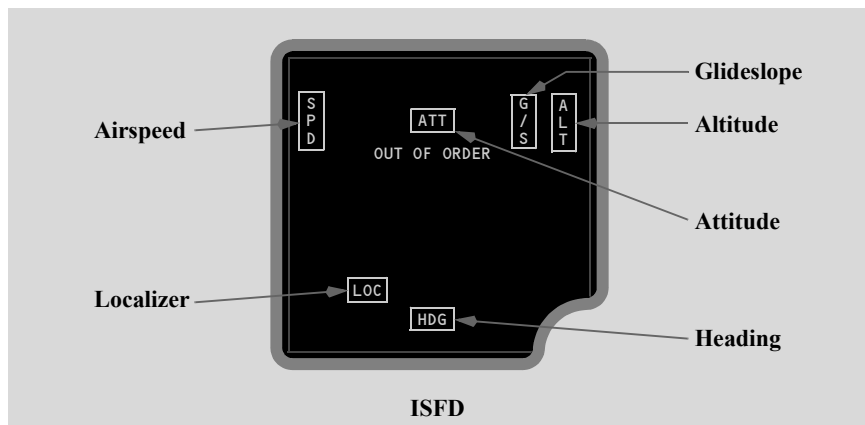
INIT 90s (amber) - countdown of 90 second initialization -

- countdown stops if excessive motion is detected
- countdown resumes when motion stops
- ATT:RST displays if initialization is not complete within six minutes.

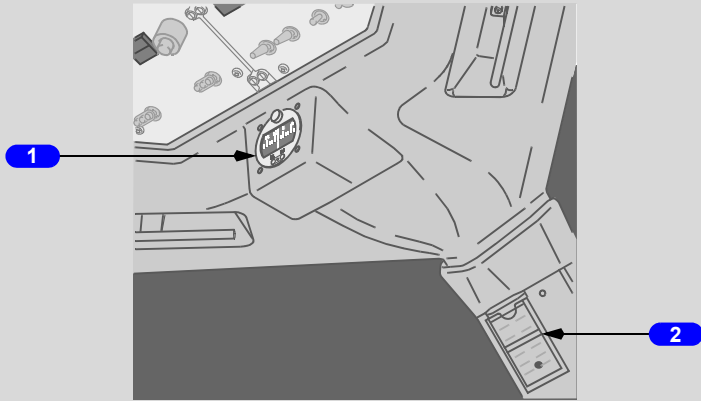
ISFD Failure Flags

Failure flag replaces appropriate display.

OUT OF ORDER indicates instrument system failure.



Standby Magnetic Compass



CENTER POST ABOVE GLARESHIELD

1 Standby Magnetic Compass

Displays magnetic heading.

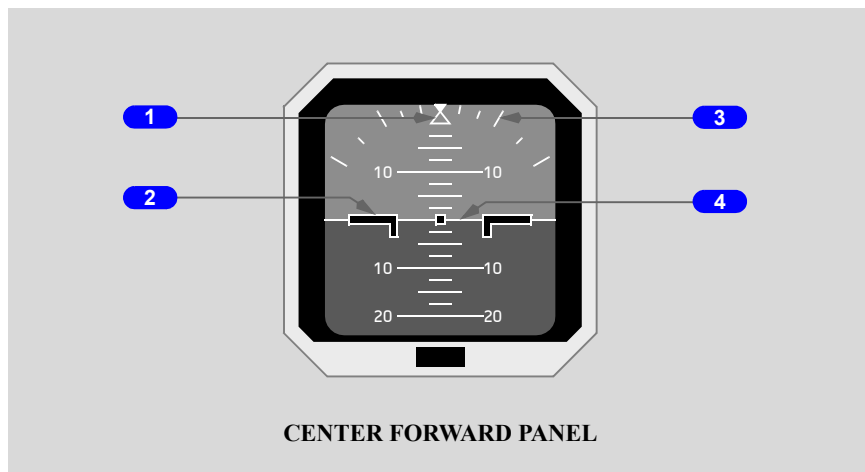
2 Standby Magnetic Compass Correction Card

Provides appropriate heading corrections.

Standby Attitude Indicator

[non ISFD airplanes]

The standby attitude indicator displays SAARU attitude.



1 Bank Pointer

Indicates airplane bank.

2 Airplane Symbol

Indicates airplane attitude with reference to the SAARU horizon.

3 Bank Scale

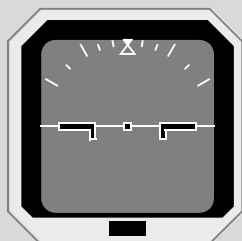
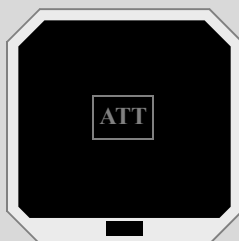
Fixed reference for the bank pointer.

Scale marks are at 0, 10, 20, 30, 45, and 60 degrees.

4 Horizon Line and Pitch Scale

Indicates the SAARU horizon relative to the airplane symbol.

Pitch scale is in 2.5 degree increments.

Standby Attitude Indicator Non Normal Displays**No Computed Data****Failure Display****Program Pin Error**

No Computed Data – No computed data from the SAARU.

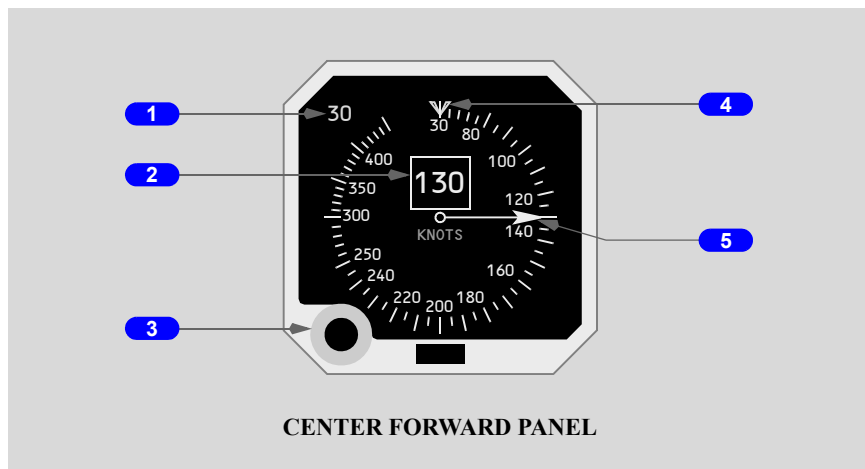
Failure Display – Data from the SAARU fails.

Program Pin Error – Program pin connection invalid.

Standby Airspeed Indicator

[non ISFD airplanes]

The standby airspeed indicator displays airspeed from a dedicated pitot and static air data module. The indicator does not use ADIRU or SAARU information.



1 Selected Speed

Displays the speed selected with the bug selector and indicated by the standby airspeed bug.

2 Current Standby Airspeed

Displays current airspeed.

3 Standby Airspeed Bug Selector

Rotate (outer) – adjusts the standby airspeed bug.

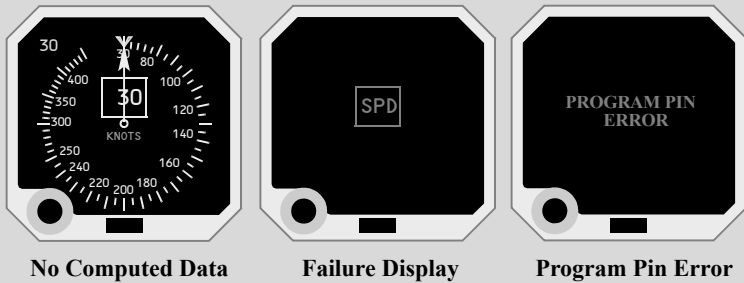
Push (inner) – turns the standby airspeed display bug off and on.

4 Standby Airspeed Bug

Points to the speed selected with the bug selector.

5 Current Standby Airspeed Pointer

Indicates current airspeed.

Standby Airspeed Indicator Non Normal Displays

No Computed Data – No input or airspeed 30 knots or less.

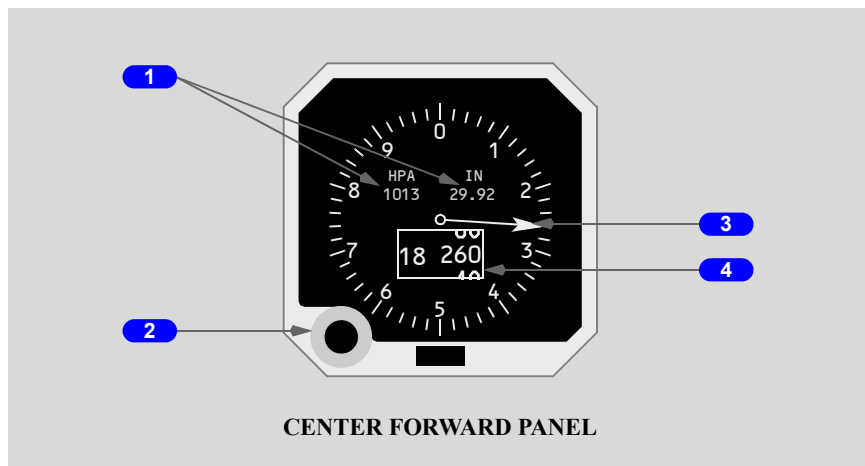
Failure Display – Indicator of air data input fails.

Program Pin Error – Program pin connection invalid.

Standby Altimeter

[non ISFD airplanes]

The standby altimeter displays barometric altitude from a dedicated air data module.



1 Barometric Reference

Indicates the selected barometric reference in inches (IN) and Hectopascals (HPA).

2 Standby Barometric Selector

Rotate (outer) – adjusts the altimeter barometric reference.

Push (inner) – switches between standard and the last selected barometric reference.

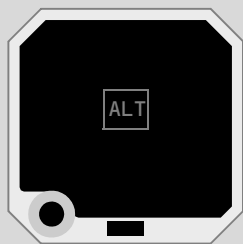
3 Altitude Pointer

Indicates barometric altitude in hundreds of feet.

One full rotation of the pointer is 1000 feet.

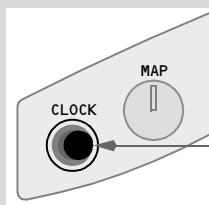
4 Current Altitude

Indicates barometric altitude.

Standby Altimeter Indicator Non Normal Displays**Failure Display****Program Pin Error**

Failure Display – No computed data or indicator failure.

Program Pin Error – Program pin connection invalid.

Clock**GLARESHIELD
PANEL****FORWARD PANELS****1 Chronograph (CHR or CLOCK) Switch**

Push – subsequent pushing starts, stops, resets the chronograph.

2 Chronograph Pointer

Indicates chronograph seconds.

3 Elapsed Time (ET) Selector

Controls the elapsed time function.

RESET – returns ET display to zero (spring loaded to HLD).

HLD (hold) – stops the elapsed time display.

RUN – starts the elapsed time display.

4 Time/Date Selector

MAN (Manual) – the clock is manually set to a time and date.

UTC – the clock is automatically set to the UTC date and time.

Push –

- alternately displays the day–month, then year in the time/date window
- subsequent selection displays only the time in the time/date window.

5 Time/Date Window

Displays time (hours, minutes) when time is selected on the time/date selector.

Alternately displays day–month and year when date is selected on the time/date selector.

6 Elapsed Time (ET)/Chronograph (CHR) Window

Displays elapsed time (hours, minutes) or chronograph minutes.

The chronograph display replaces the elapsed time display.

Elapsed time continues to run in the background and will be displayed after the chronograph is reset.

7 Clock Set Selector

Sets the time and date when the time/date selector is set to manual.

HD (hours, day) –

- advances hours when time is selected on the time/date selector
- advances days when date is selected on the time/date selector.

MM (minutes, month) –

- advances minutes when time is selected on the time/date selector
- advances months when date is selected on the time/date selector.

HLDY (hold, year) –

- stops the time indicator and sets the seconds to zero when time is selected on the time/date selector
- advances years when date is selected on the time/date selector.

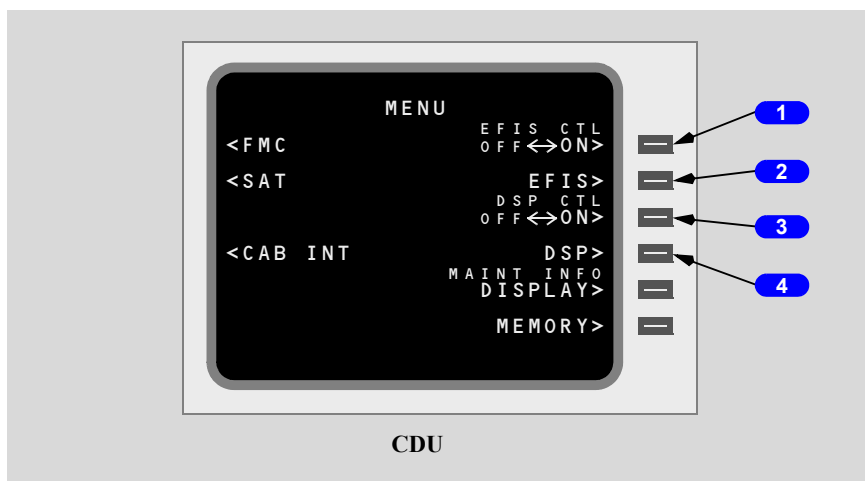
RUN – starts the time indicator.

EFIS Control Panels and Display Select Panel (DSP) – CDU Alternate Control

The CDU provides an alternate way to control the functions of the EFIS control panel and/or the display select panel.

Note: The control callouts on the following pages correspond to the control names on the EFIS control panels and the display select panel. Explanations of the CDU functions are the same as on the related control panels.

CDU EFIS/DSP Control Selection



1 EFIS Control (CTL) Select Key

Transfers control of the EFIS from the EFIS control panel to the CDU (left EFIS control panel transfers to the left CDU, right EFIS control panel transfers to the right CDU).

2 EFIS Page Select Key

Selects the EFIS CONTROL page when EFIS control is on.

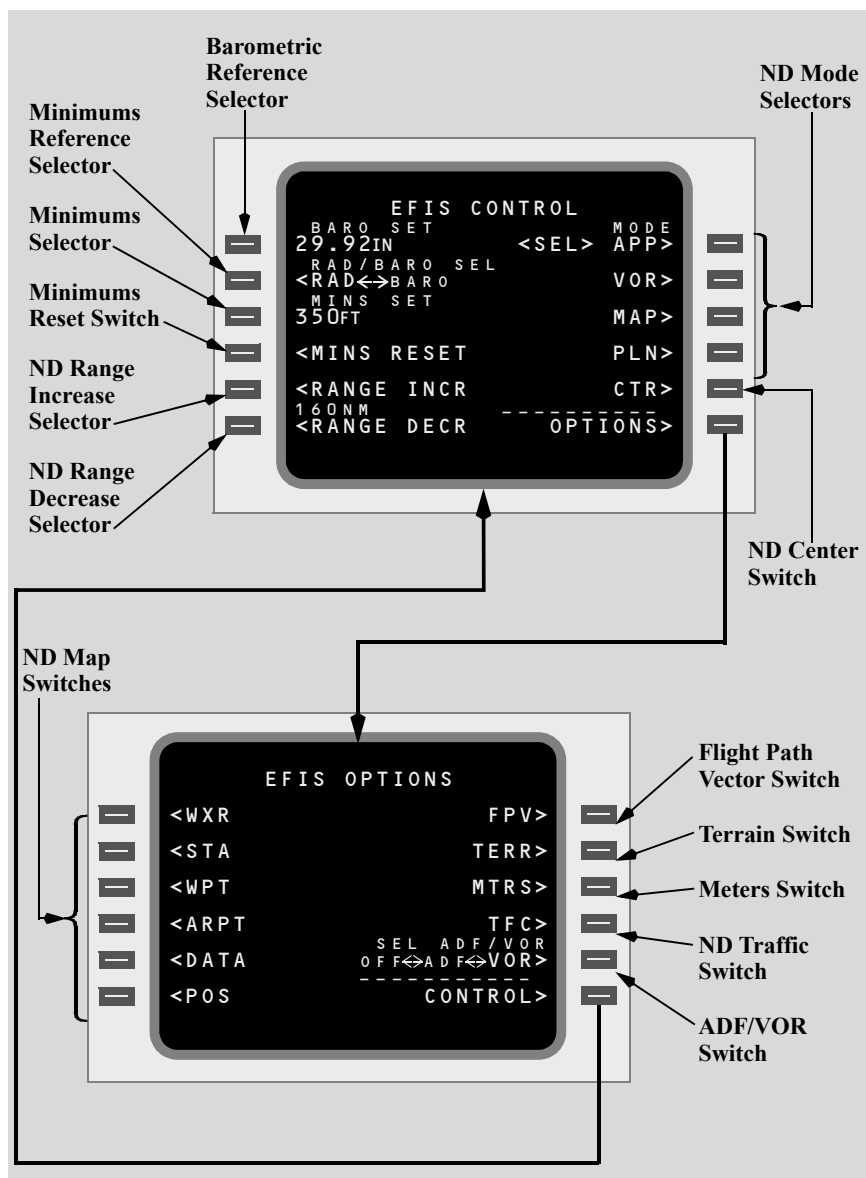
3 Display Select Panel Control (DSP CTL) Select Key

Transfers control of the display select panel control from the display select panel to the CDU.

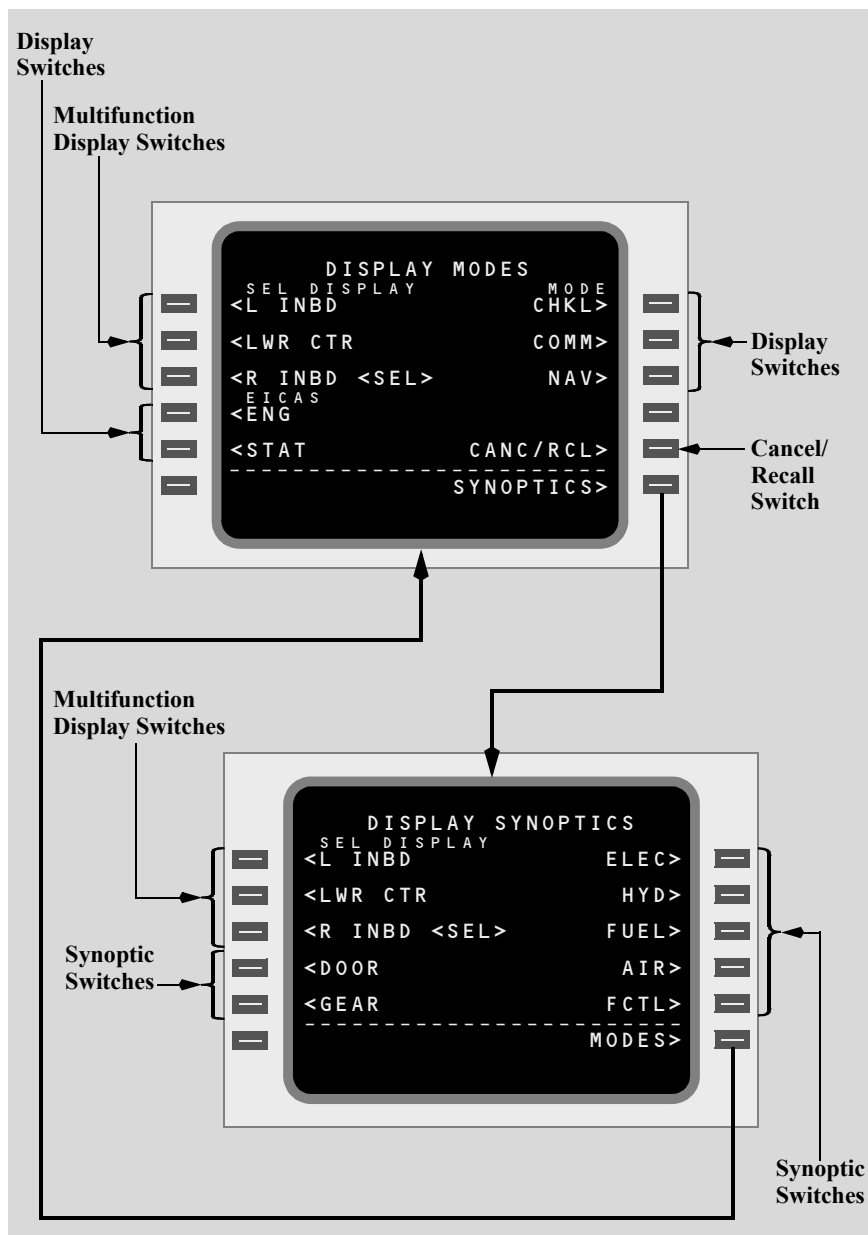
4 Display Select Panel (DSP) Page Select Key

Selects the DISPLAY SELECT PANEL CONTROL page when the DSP control is on.

EFIS Control CDU Pages



Display Select CDU Pages



Intentionally
Blank

Flight Instruments, Displays
System Description**Chapter 10**
Section 20**Introduction**

The flight instruments and displays supply information to the flight crew on six flat panel liquid crystal display units. The units display four primary groups of information:

- the primary flight display (PFD)
- the navigation display (ND)
- the engine indication and crew alerting system (EICAS)
- the multifunction display (MFD).

Detailed information on the following subjects is found in other sections of this chapter:

- PFD – Section 30
- ND – Section 40
- Electronic Checklist – Sections 50 and 60.

Display Selection and Control

During normal operations:

- the inboard display selectors are set to MFD
- PFDs are displayed on the two outboard display units
- NDs are displayed on the two inboard display units
- EICAS is displayed on the upper center display unit
- the display select panel–selected MFD information is displayed on the lower center display unit, or the display is blank. (The secondary engine display is the default display at power–up.)

Inboard Display Selectors

The inboard display selectors are used to select PFD, ND (NAV position), MFD, or EICAS displays on the inboard display units.

The normal position is MFD. With MFD selected, ND information is displayed on the inboard display units if NAV is selected on the display select panel (refer to Display Select Panel in this section).

In the ND, PFD, and EICAS positions, only the selected displays can appear on the inboard display units.

With MFD selected on the inboard display selector, the following ND and EFIS control logic applies:

- if both pilots have an ND on the inboard displays, then each EFIS control panel controls its corresponding ND display
- if there is an ND display on one inboard display unit and on the lower center display unit, then the pilot who does not have an ND on the inboard display unit controls the ND on the lower center display unit
- if neither pilot has an ND display on the inboard display unit, and there is an ND display on the lower center display unit, then the left EFIS control panel controls the lower center display unit
- if both pilots have an ND display on the inboard display unit, and there is an ND on the lower center display unit, then the left EFIS control panel controls the left inboard display unit and the lower center display unit. The ND on the left inboard and the lower center display units are identical.

EFIS Control Panels

The EFIS control panels control display options, mode, and range for the respective PFDs and NDs. Refer to the PFD and ND sections of this chapter.

If an EFIS control panel fails, the displays can be controlled through the related CDU. This CDU capability is available at all times, but inhibits inputs from the respective EFIS control panel.

Display Select Panel

The display select panel controls the MFD format on the left and right inboard display units and the lower center display unit. The selected display is indicated by the illuminated annunciator light on the display select panel (L INBD, R INBD, LWR CTR).

[\[777–300, 777-300 ER Ground Maneuver Camera System and Flight Deck Security Video on MFD option shown\]](#)

After a display unit is selected, the appropriate display is selected (ENG, STAT, ELEC, HYD, FUEL, AIR, DOOR, GEAR, FCTL, CAM, CHKL, COMM, or NAV on the DSP, or FDEVSS by the DSPL switch on the flight deck entry video panel).

A new display selection automatically replaces the previous one. A second selection of the same display for the lower center display unit blanks the display. A second selection of the same display on either inboard display causes display of the ND. If there is more than one page of messages, pushing STAT pages through the messages.

Pushing the COMM or CHKL switch for either inboard display unit shows the selected display. The cursor automatically appears on the selected display.

Display select panel control is also available through any CDU. This capability is available at all times. Once display select panel control is selected on one CDU, it cannot be selected on the other two CDUs.

When used as an MFD, the lower center display unit and the two inboard display units can display the following displays:

- ND (NAV switch)
- status page (STAT switch)
- secondary engine EICAS (ENG switch)
- system synoptics (ELEC, HYD, FUEL AIR, DOOR, GEAR, FCTL switches)
- communications pages (COMM switch)
- electronic checklist (CHKL switch)

[\[777-300, 777-300ER Ground Maneuver Camera System\]](#)

- ground maneuver camera system display (CAM switch)

[\[Option - Flight Deck Security Video on MFD\]](#)

- flight deck entry video security system (flight deck entry video panel DSPL switch)

When an inboard display selector is in the PFD position, new displays selected from the display select panel to that inboard display are inhibited. The annunciator light above the associated display select panel switch is also inhibited.

When an inboard display selector is in the EICAS position, only the ENG, AIR, and FUEL switches can affect the display. Pushing one of those switches causes the display of the respective compacted blocks of information on the EICAS display. The cancel/recall switch operates normally. Refer to these chapters for more information on compact EICAS displays:

- Chapter 2, Air Systems
- Chapter 7, Engines, APU
- Chapter 12, Fuel.

The inboard display selectors have no effect on the inboard displays if an outboard display unit fails; the PFD automatically moves to the inboard display unit regardless of the position of the inboard display selector.

Upper center display unit failure automatically switches the EICAS display to the lower center display unit. A subsequent EICAS selection on either of the inboard display selectors brings the EICAS display to that inboard display unit, and assuming no latched condition exists, the lower center display unit initially displays secondary engine instruments. Following this initial display configuration, the lower center display unit can be used in its usual MFD mode.

Display Brightness Control

The MASTER BRIGHTNESS control provides simultaneous brightness adjustment for all displays and panel lighting. Also, each display unit has an individual control with limited range control when master brightness is on, and full range control when master brightness is off.

Two remote light sensors, located left and right on the top of the glareshield, measure brightness in the forward field of view and adjust the overall display brightness as required. Individual sensors on the front of each display unit also affect display brightness. The CDUs, mode control panel displays, standby flight instruments, and aisle stand panel displays are also controlled by the automatic display brightness control system.

Instrument Display Source Selection

The display system automatically reconfigures to compensate for most faults. The instrument display source select panels provide manual switches for the pilots to use if certain faults are not corrected automatically.

Instrument source select switches provide alternate information sources for the PFDs and NDs. These switches provide automatic source selection when in the off position (switch out, with the ALTN and CDU switch annunciations not visible).

If there is an undetected source failure (a display is missing or parts of a display appear faulty), the non-normal (ALTN or CDU) position provides the capability for manual selection of PFD and ND sources.

Undetected display source failures, such as missing/faulty display information or intermittent display blanking, may not result in automatic switching. The CDU position of the NAV switch or the ALTN position of the DSPL CTRL or AIR DATA/ATT switches provide the capability to manually select PFD and ND sources.

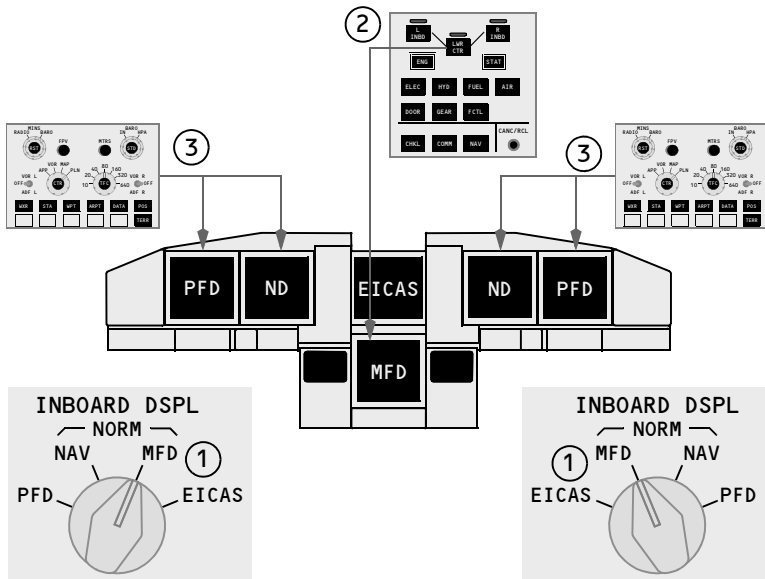
A center display control source switch is provided for the center displays.

Display Selection and Control Examples

The following examples show display selections.

Normal Display Configuration

- ① The INBOARD DISPLAY selectors are set to MFD.
- ② The lower center display unit is the preferred MFD controlled by the display select panel.
- ③ The outboard display units display PFDs and the inboard display units display NDs. The related control panel controls what is on the PFD and ND.

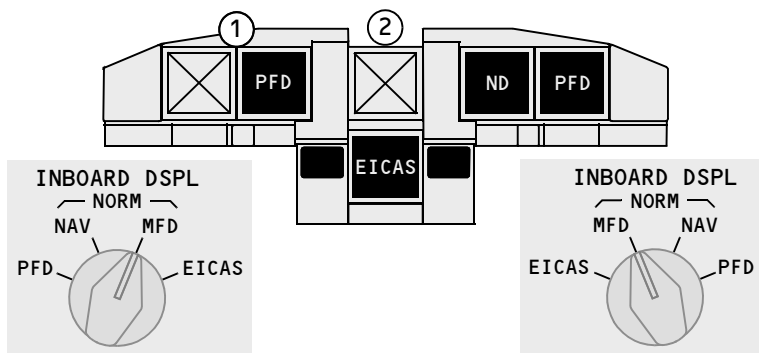


Display Unit Failure Automatic Switching

- ① If an outboard display unit fails, the PFD automatically moves to the inboard display unit. The INBOARD DISPLAY selector and the display select panel no longer have any control over that inboard display unit.
- ② If the upper center display unit fails, the EICAS display automatically moves to the lower center display unit.

Pushing the ENG display switch switches EICAS between primary and compacted modes if no pop-up condition is active.

The display select panel can still display compact engine, air and fuel synoptics. The CANCEL/RECALL switch operates normally.

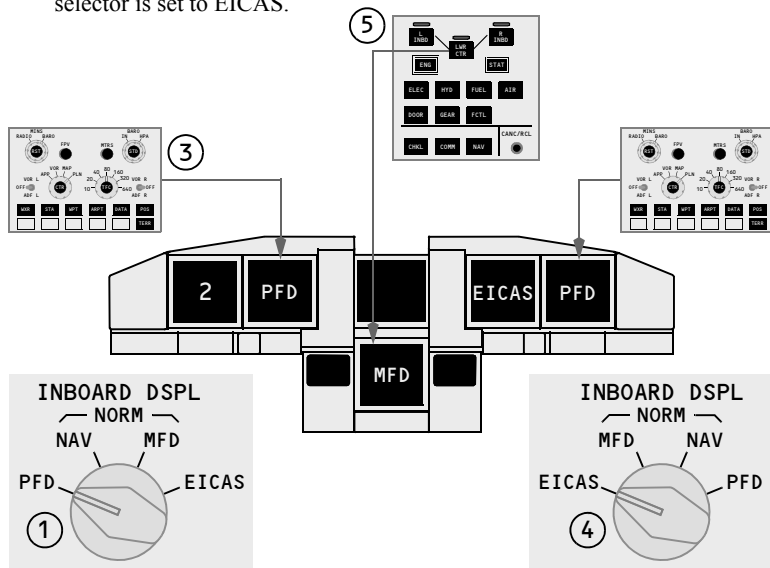


Inboard Display Switching

- ① The left INBOARD DISPLAY selector is set to PFD.
With an INBOARD DISPLAY selector in any position other than MFD, the selector position alone determines what is displayed on the display unit. The left inboard display cannot display any selections made on the display select panel.
- ② The left outboard display blanks and the PFD moves to the left inboard display unit.
- ③ The left EFIS control panel controls the PFD.
- ④ The right INBOARD DISPLAY selector is set to EICAS.

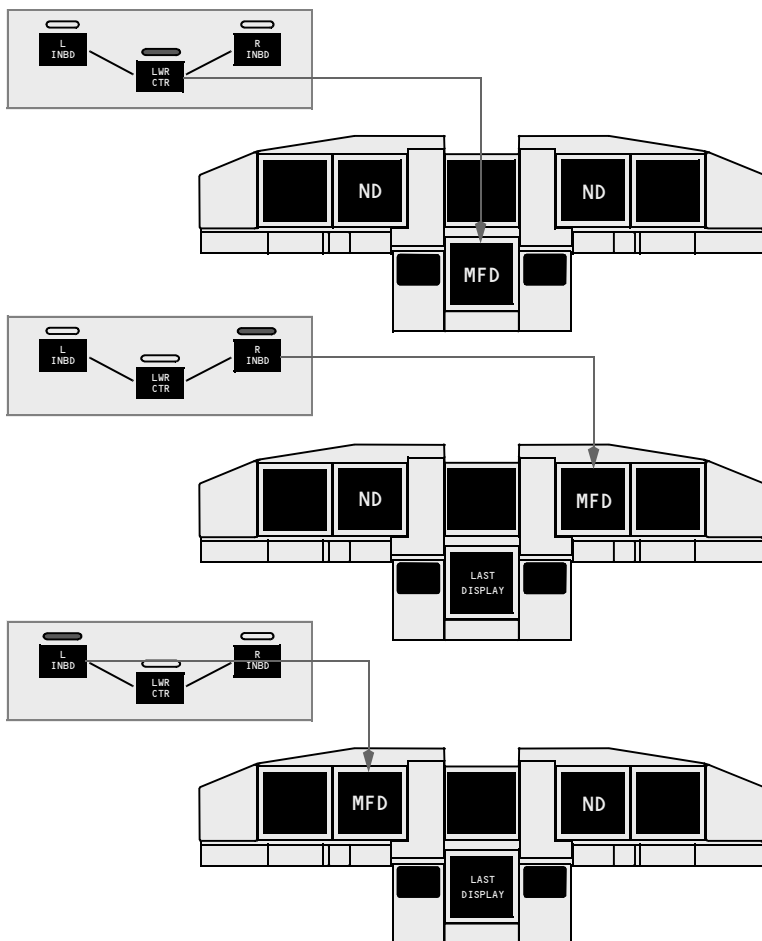
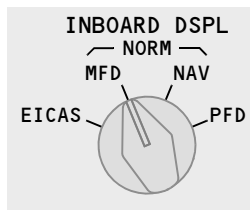
The right inboard display cannot display selections made on the display select panel, except for compact engine, air and fuel synoptics, and the CANCEL/RECALL switch functions.

- ⑤ The upper center display blanks and the EICAS display moves to the right inboard display unit. Now there is no ND visible. Either pilot could use the display select panel to display an ND on the lower center display unit (refer to the following pages).



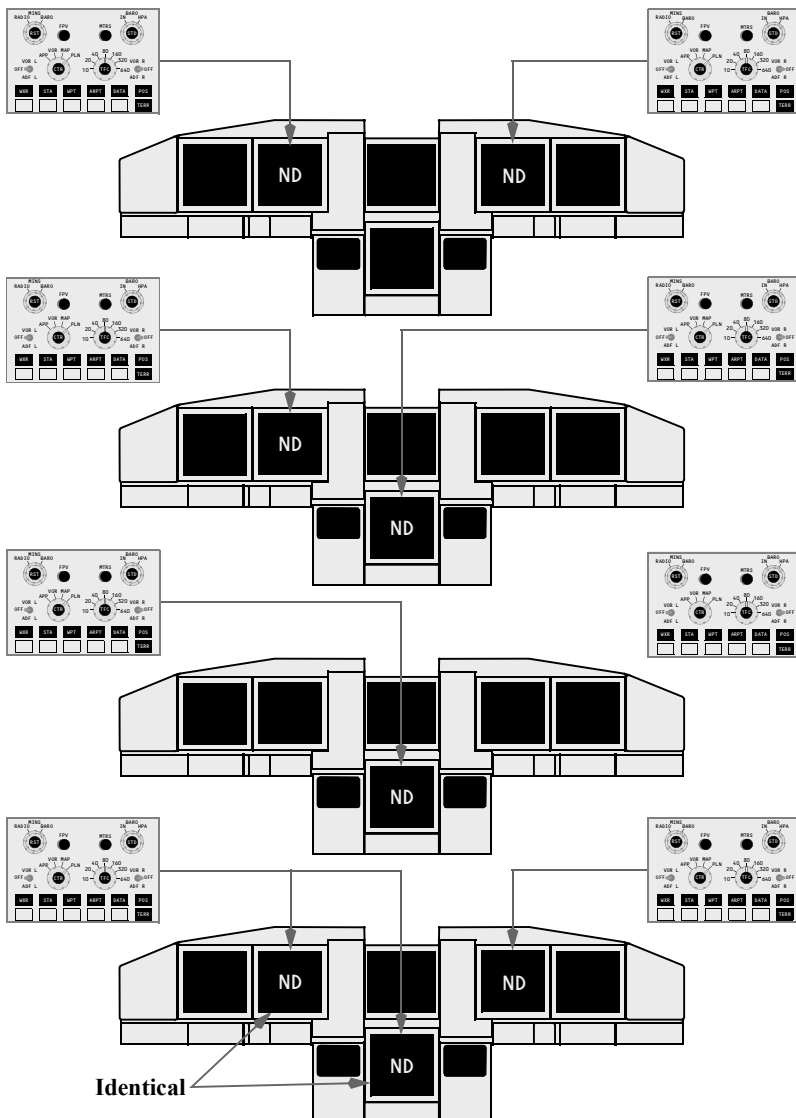
Display Select Panel MFD Selection

With the INBOARD DISPLAY selectors set to MFD, the display select panel display switches are used to designate a display as an MFD. The designated display (L INBD, LWR CTR, or R INBD) is then controlled by the other display select panel selections (ENG, STAT, CHKL, COMM, NAV or one of the system synoptics).



EFIS Control Panel Multiple ND Control

This shows which EFIS control panel controls which ND when multiple NDs are displayed, or when the ND is displayed on the lower center display unit.



Ground Maneuver Camera System

[777-300, 777-300ER]

The ground maneuver camera system provides the flight crew with views of the nose gear and main gear areas during taxi operations.

The system has three cameras. The cameras supply a color image to a three-way split screen display on any multifunction display (MFD).

The nose landing gear camera is on the lower side of the fuselage. The nose landing gear camera video is displayed on the upper section of the MFD ground maneuver camera display.

The left and right main landing gear cameras are on the leading edges of the respective horizontal stabilizer. The left and right main landing gear camera video is displayed on the lower section of the ground maneuver camera display. The system automatically compensates for approximately 80 percent of stabilizer movement to keep the cameras pointed correctly.

A black stripe is painted on the top of each wing to provide guidance when the tires are in shadow. The outboard edge of each stripe corresponds to the location of the outboard tire faces on each main landing gear.

The camera windows are heated to prevent the formation of ice, frost, or condensation from blocking the camera view. Window heat operates automatically when the cameras are operating.

The camera (CAM) display switch on the display select panel (DSP) is pushed to display the ground maneuver camera system video on a multifunction display (MFD). The system is powered whenever airplane AC electrical power is available and the In-Flight Entertainment System/Passenger Seats (IFE/PASS SEATS) Power Switch is ON.

To display ground maneuvering camera system video images while viewing surveillance video, select an appropriate MFD, and press CAM on the display select panel twice.

Ground maneuver camera lights can be turned with the CAMERA LTS switch on the overhead panel. The BEACON switch must be on and the nose landing gear down for the camera lights to operate. The lights are located on the outboard flap track fairing of each wing and on the aft side of the nose landing gear strut.

Flight Deck Entry Video Surveillance System (FDEVSS)

[Option – Flight Deck Security Video on MFD]

The flight deck entry video surveillance system provides video images of the flight deck door entrance area under all lighting conditions, enabling positive identification of anyone requesting access to the flight deck.

The system consists of three cameras with infrared illumination, a flight deck entry video panel, and a video interface unit. The cameras are mounted in the forward cabin and are positioned to capture different viewing angles of anyone near the flight deck door entrance area. The flight deck entry video panel is located on the aft aisle stand. Surveillance video may be displayed on one of the L INBD, LWR CTR, or R INBD MFDs or all of them simultaneously.

Control and Operation

The IFE/PASS SEATS switch controls power to the flight deck entry video surveillance system. The MFD switches on the DSP are used to select a display unit. If selecting an inboard display, the appropriate left or right INBOARD DSPL selector must be set to MFD.

The flight deck entry video panel consists of a display switch and a camera selector. Pushing the display switch activates display of surveillance video on the selected MFD. Rotating the camera selector allows selection of the desired viewing angle. By repeating the selection process, different surveillance videos may be displayed on different MFDs simultaneously. To display surveillance video while displaying ground maneuvering camera video, select an MFD and press DSPL on the Flight Deck Entry Video Panel twice. Once displayed, pushing the display switch cancels surveillance video on the selected MFD and causes the display unit to either blank (LWR CTR) or revert to ND (L or R INBD). Pushing any DSP display/synoptic switch also cancels surveillance video on the selected MFD.

Cursor Control Devices (CCD)

The CCDs provide control of the display cursor.

For detailed information on the following subjects, refer to:

- Chapter 5, Communications
- the Electronic Checklist sections in this chapter
- the Electronic Flight Bag section in this chapter

CCD Touch Pad

The CCD uses a touch pad. Touching the pad translates the touch location coordinates to the affected display, placing a cursor at those coordinates on the selected display.

The cursor moves relative to finger movement across the touch pad. Except for the four corners of the touch pad, lifting the finger off the touch pad and touching a different location does not move the cursor. Only finger motion in contact with the touch pad moves the cursor.

Touching a corner immediately places the cursor in the corresponding corner of the display. This helps the pilot quickly locate the cursor and speeds access to the selections at the four corners of the display.

CCD Cursor Location Control

Selecting a menu, communications, or checklist function requires the use of the cursor location switches.

If a new function is selected on an inboard display that requires a communication, checklist, or maintenance function, then the system automatically selects the respective cursor control device to that display.

If a new function requiring a cursor is selected on the lower center display, then the system automatically selects the CCD not currently being used on an inboard display to the lower center display. If neither cursor is in use, it selects the CCD cursor that was previously displayed on the lower center display. Cursor selection defaults to the left CCD on power-up.

The cursor location light above the switch illuminates to indicate the selected display unit.

Selecting a display where there is no function requiring a cursor has no effect. For example, if the inboard display does not display a communications or checklist page, pushing an INBD cursor location switch has no effect on the selected inboard display.

Only one CCD can access a given display at a time. The last pilot who selects the cursor on the selected MFD has control. The other cursor disappears from the display and the cursor location light on that CCD extinguishes. The cursors are visually different so the pilots know who is currently in control of the cursor on a display.

If both pilots are accessing the same checklist or communications functions on different displays, both are forced to the same page, with that page controlled by the pilot with cursor control.

Standby Flight Instruments

The standby flight instruments include:

[ISFD airplanes]

- integrated standby flight display
- standby magnetic compass.

[non ISFD airplanes]

- standby attitude indicator
- standby altimeter
- standby airspeed indicator
- standby magnetic compass.

Integrated Standby Flight Display (ISFD)

The ISFD displays attitude, airspeed, altitude, ILS, and magnetic heading information. The ISFD receives airspeed and altitude from a dedicated pitot and static air data module. Attitude information is provided by internal inertial sensors. ILS information is provided by the center ILS receiver. The display receives its heading information from the same source as the captain's primary flight display. Heading information is not available in polar regions.

Note: The standby magnetic compass must be used to validate heading information.

The left FCDC bus powers the ISFD. The left FCDC is initially powered when the main ac busses are powered and remains powered with the main busses out. Ten seconds after receiving power, a 90 second initialization sequence begins. ATT and INIT 90s messages display during initialization. Initialization will stop if airplane movement is excessive and will resume when airplane movement is acceptable for initialization. Upon completion of the initialization sequence, attitude information displays.

Detection of a momentary out-of-limit ISFD condition may cause the attitude display to blank and the WAIT ATT or ATT:RST message to display. When the ATT:RST message displays, pushing the Attitude Reset switch resets the horizon line with the airplane symbol.

On the ground, pushing the Attitude Reset switch must be accomplished with the airplane stationary. In flight, pushing the Attitude Reset switch must be accomplished with the airplane in wings level, non-accelerated flight. During attitude reset, the ATT 10s message displays. Failure to maintain straight and level flight for 10 seconds may result in an ATT:RST message. If attitude reset is unsuccessful, the ATT:RST message remains displayed and the attitude will not be displayed.

Standby Attitude Indicator

[non ISFD airplanes]

The standby attitude indicator displays SAARU attitude. A bank indicator and pitch scale are provided.

Standby Airspeed Indicator

[non ISFD airplanes]

The standby airspeed indicator displays airspeed calculated from two standby air data modules (one pitot and one static). It provides current airspeed in knots as a digital readout box and with an airspeed pointer.

Standby Altimeter

[non ISFD airplanes]

The standby altimeter displays altitude from the standby (static) air data module. Current altitude is displayed digitally. A pointer indicates altitude in hundreds of feet. The pointer makes one complete revolution every 1,000 feet.

Standby Magnetic Compass

A standard liquid-damped magnetic standby compass is provided. A card located near the compass provides heading correction factors.

Clocks

A clock is located on each forward panel. Each clock displays airplane information management system (AIMS) generated UTC time and date, or manually set time and date. The AIMS UTC time comes from the global positioning system (GPS). In addition to time, the clocks also provide alternating day and month-year, elapsed time and chronograph functions.

Display System Information Sources

Air Data Inertial Reference System (ADIRS)

The ADIRS provides:

- primary, secondary and standby air data
- inertial reference information.

The major components of the ADIRS are:

- one air data inertial reference unit (ADIRU)
- one secondary attitude air data reference unit (SAARU)
- eight air data modules
- six static ports
- three pitot probes
- two angle-of-attack vanes
- one total air temperature probe.

Air Data Inertial Reference Unit (ADIRU)

The ADIRU is the primary source for speed, altitude, attitude and inertial navigation position information. The ADIRU processes information measured by its internal gyros and accelerometers, and from air data module inputs, angle-of-attack vanes and other systems.

The ADIRU is described in Chapter 11, Flight Management, Navigation.

Secondary Attitude Air Data Reference Unit (SAARU)

The SAARU is the secondary source for speed, altitude, and attitude information. The SAARU processes information measured by its internal gyros and accelerometers, and from air data module inputs, angle-of-attack vanes, and other systems.

[non ISFD airplanes]

The SAARU also transmits roll and pitch attitude information to the standby attitude display.

The SAARU does not provide navigational position data. The SAARU is described in Chapter 11, Flight Management, Navigation.

Air Data

Three static ports are located on the left side of the airplane and three static ports are located on the right side of the airplane. Left and right static ports are paired through pneumatic tubing to each of the left, center and right air data modules. The air data modules convert static air pressure to a digital output for use by other systems. The center static ports are also connected to an independent air data module to provide static pressure to the standby airspeed indicator and the standby altimeter.

Two pitot probes (right and center) are mounted on the right forward section of the airplane. One pitot probe (left) is mounted on the left forward section of the airplane. An air data module is connected to each pitot probe. These air data modules convert dynamic air pressure to a digital output for use by other systems. The center pitot probe also provides dynamic pressure to the standby air data module.

Angle-of-Attack

There are two angle-of-attack vanes, one located on each side of the forward fuselage. The vanes measure airplane angle-of-attack relative to the air mass.

[Option - AOA Indication]

The primary source of data for the AOA indicator on the PFD is supplied by the ADIRU, with the SAARU as the backup source. The source selection is automatic in the event of primary source failure.

Total Air Temperature

A total air temperature probe is mounted outside the airplane to sense air mass temperature. The temperature sensed by the probe is used by the ADIRU and the SAARU to compute total air temperature.

Static Air Temperature

Static air temperature, displayed on the CDU PROGRESS page, comes from the ADIRU, using total air temperature probe information. In the event the ADIRU value is invalid, the SAARU computed value is displayed.

Flight Instruments, Displays
Primary Flight Displays (PFDs)**Chapter 10**
Section 30**Introduction**

The PFDs present a dynamic color display of all the parameters necessary for flight path control. The PFDs provide the following information:

- flight mode annunciation
- airspeed
- radio altitude

[Option]**[Option]**

- ground speed
- altitude
- vertical speed
- attitude
- steering information
- angle of attack
- instrument landing system display
- approach minimums
- heading/track indications
- engine fail, GPWS, and PWS alerts
- Navigation Performance Scales

Failure flags are displayed for airplane system failures. Displayed information is removed or replaced by dashes if no valid information is available to the display system (because of out-of-range or malfunctioning navigation aids). Displays are removed when a source fails or when no system source information is available.

Flight mode annunciations are described in Chapter 4, Automatic Flight.

Airspeed

Airspeed is displayed on a tape and in a digital window on the left side of the PFD. The current Mach number is digitally displayed below the airspeed tape when the current Mach number is greater than 0.40. An airspeed trend vector indicates predicted airspeed in 10 seconds. Selected airspeed is displayed above the airspeed tape.

Takeoff and landing reference speeds and flap maneuvering speeds are shown along the right edge of the airspeed tape. Maximum and minimum airspeeds are also displayed along the right edge of the airspeed tape.

CAUTION: Reduced maneuver capability exists when operating within the amber regions below the minimum maneuvering speed or above the maximum maneuvering speed. During non-normal conditions the target speed may be below the minimum maneuvering speed.

Ground Speed

[Option]

Ground speed is digitally displayed below the airspeed tape when the Mach number is less than 0.40.

Altitude

Altitude is displayed on an altitude tape along the right side of the PFD. It is also shown digitally in a window in the middle of the tape. When meters is selected on the EFIS control panel:

- current altitude in meters is also shown above the altitude window
- selected altitude in meters is displayed above the altitude tape.

Selected altitude is displayed above the altitude tape and is boxed when approaching the selected altitude. Selected altitude is also depicted with a bug on the altitude tape.

[Option – Minimums Pointer, RA Minimums BARO Bug and No Line]

The selected barometric approach minimum is indicated on the altitude tape with a triangular pointer and a line when BARO minimums are selected. When RADIO minimums are selected, the pointer is still set at BARO minimums; there is no line.

[Option – Landing Altitude Reference Bar]

A landing altitude reference bar is displayed along the inner edge of the altitude indication. The reference bar indicates the height above touchdown. A white bar is displayed from 1000 to 500 feet above landing altitude. An amber bar is displayed from 500 feet to the landing altitude.

The current barometric reference is displayed below the altitude tape. A preselected barometric reference can be displayed when STD is displayed.

Landing reference is selectable between QNH and QFE on the APPROACH REF page of the FMC. QNH is the normal operating mode. Selecting QFE sets the destination landing altitude indication to zero altitude. With the landing reference set to QFE, changing the barometric setting from STD to QFE changes the PFD altitude tape background color to green. With QFE selected and climb mode active, changing the barometric setting from QFE to STD causes the landing reference to toggle from QFE to QNH and the altitude tape background color changing from green back to normal. A description of QFE operation is contained in the Landing Reference description in Chapter 11, Flight Management, Navigation.

Vertical Speed

Vertical speed is displayed to the right of the altitude tape with a tape and pointer. Vertical speed is digitally displayed above or below the vertical speed display when vertical speed is greater than 400 feet per minute. It is displayed above with positive vertical speed and below with negative vertical speed. The selected vertical speed bug shows the selected vertical speed when in the AFDS vertical speed (V/S) pitch mode.

Attitude

The attitude indication displays the airplane pitch and roll attitude referenced to the horizon.

Pitch attitude is displayed by an airplane symbol against a pitch scale. The pitch scale is in 2.5 degree increments.

A pointer indicates bank angle in increments of 10, 20, and 30 degrees. Single marks indicate 45 and 60 degrees of bank. A small rectangle under the bank angle pointer indicates slip and skid conditions. Bank angle is also represented by the attitude of the airplane symbol against the horizon line and pitch scale.

A pitch limit indication is displayed at low speeds when the flaps are up and at all times when the flaps are down.

Steering Indications

The flight director steering indications are displayed when the associated flight director switch is on.

TCAS resolution advisories are displayed in the attitude indication area. Refer to Chapter 15, Warning Systems.

The flight path vector (FPV) symbol represents airplane flight path angle vertically and drift angle laterally. The flight path vector is displayed on the PFD when the EFIS control panel FPV switch is selected on, or the MCP FPA reference switch is selected on. The FPV shows the Flight Path Angle (FPA) above or below the horizon line and drift angle left or right of the pitch scale's center. The FPA uses inertial and barometric altitude inputs. The vertical FPA is unreliable with unreliable primary altitude displays.

The flight path angle (FPA) symbol shows the selected flight path angle when the MCP FPA reference switch is selected on and either the flight director or autopilot is engaged.

The FPV and FPA symbols are displayed in two sizes and brightness levels. The large, bright FPV/FPA symbols are displayed when the previously stated selections are made and the flight director is off. The small, dim FPV/FPA symbols are displayed when the previously stated selections are made and the flight director is displayed.

Radio Altitude

[Option – Basic Numeric RA Display]

The current radio altitude is displayed in the bottom center of the attitude indication area when radio altitude is below 2,500 feet AGL.

Angle of Attack

The angle of attack is displayed above the upper right corner of the attitude indication area. Digital and round dial formats are used.

Stick shaker indicator, zero reference line, and approach reference band are displayed on the round dial.

The zero degree reference line is the 4:30 position with additional reference lines every 5 degrees from -5 to +20 degrees.

Instrument Landing System Indications

ILS glide slope and localizer deviation, frequency/identification, DME, course, and marker beacon indications are provided.

The approach reference information appears above and to the left of the attitude display. The ILS station identification or frequency, course, and (if available) DME are displayed.

The marker beacon indication (OM – outer marker, IM – inner marker, or MM – middle marker) is displayed in the upper right corner of the attitude display area.

The glideslope pointer and scale appear on the right side of the attitude indication.

The localizer pointer and scale appear at the bottom of the attitude indication.

[Option – Rising Runway]

Below 2500 feet radio altitude, with the localizer pointer in view, a rising runway symbol comes into view. The symbol provides lateral guidance. At 200 feet radio altitude, the symbol rises toward the airplane symbol.

Approach Minimums

[Option – Baro/Radio Minimums Altitude Display]

The selected radio altitude or barometric approach minimums set on the EFIS control panel are displayed near the bottom left of the altitude display.

Heading/Track Indications

Selected heading/track information is displayed in the bottom section of the PFD on a section of the compass rose. Current heading is displayed under a pointer at the top of the compass rose. The MCP selected heading bug is displayed on the outside of the compass rose. The MCP selected track bug is displayed on the inside of the compass rose.

Heading or track is displayed based on the position of the MCP HDG/TRK reference switch. The selected heading or selected track is annunciated in the left half of the compass rose. The current heading/track reference (MAG/TRU) is shown in the right half of the compass rose. A line drawn perpendicular to the edge of the compass rose from the invisible center depicts the current airplane track.

Engine Fail, GPWS, and PWS Alerts

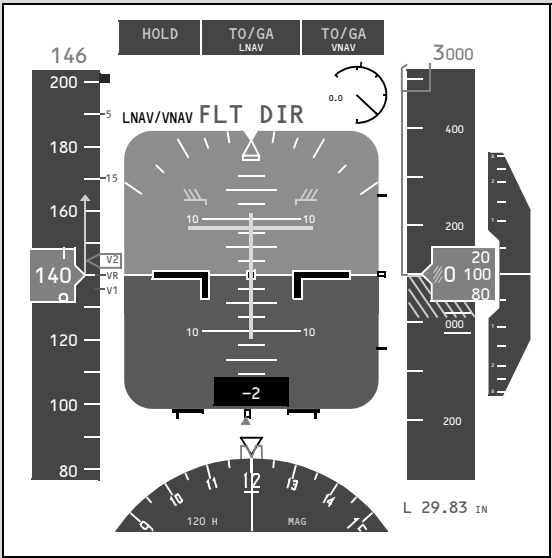
Engine fail, GPWS, and PWS alerts are displayed in large capital letters between the attitude display and the heading/track compass rose. Refer to Chapter 15, Warning Systems.

Typical PFD Displays

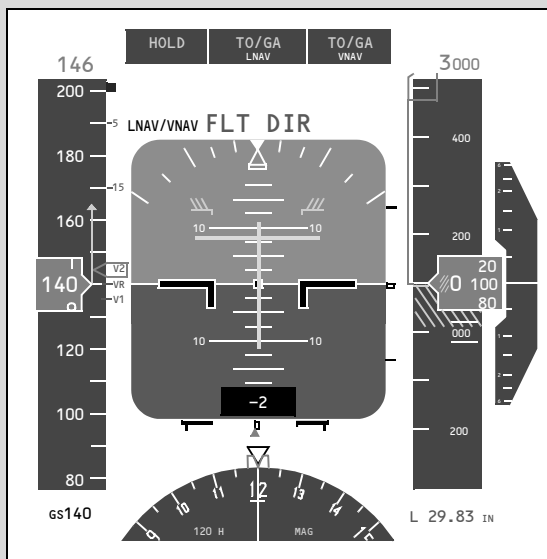
Typical PFD configurations for six phases of flight follow. The autopilot, LNAV, and VNAV are engaged for climb, cruise, descent, approach, and landing. The AFDS approach mode is used for approach and landing.

PFD Takeoff Display

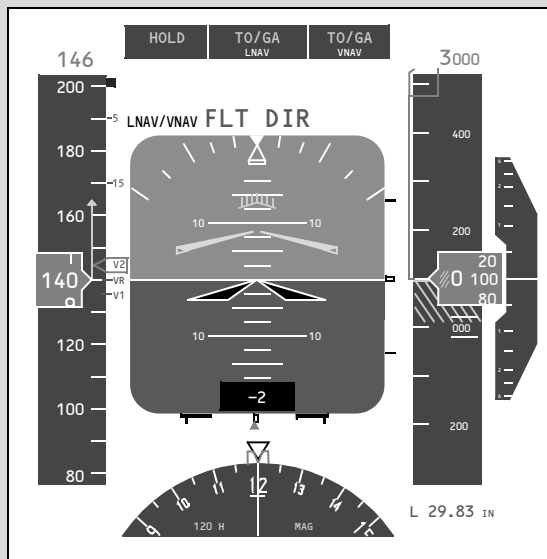
[Option - AOA Indication, Nav Perf]



[Option - Ground Speed Display, Nav Perf]

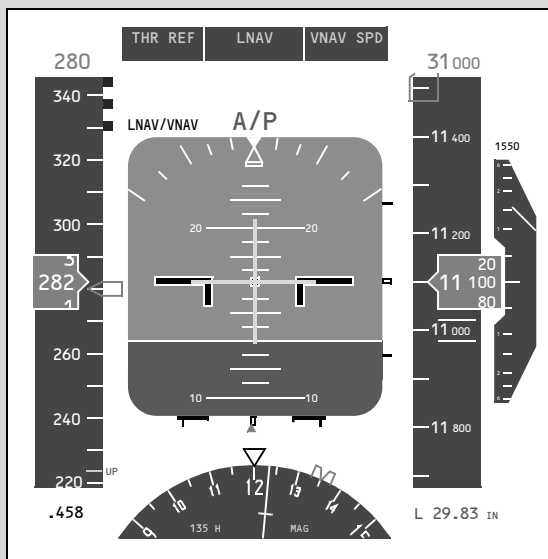


[Option - Integrated Cue Flight Director, Nav Perf]

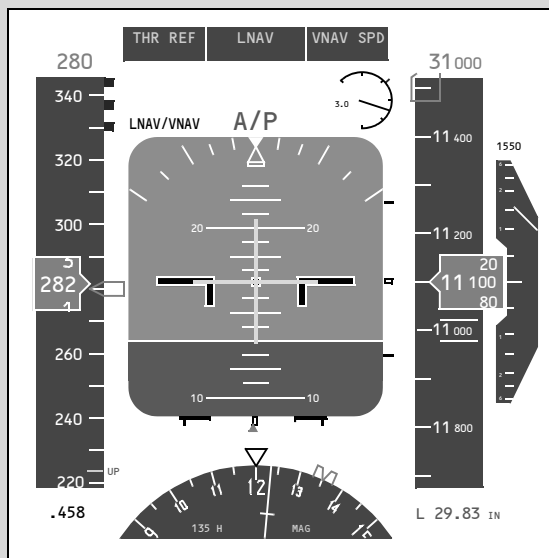


PFD Climb Display

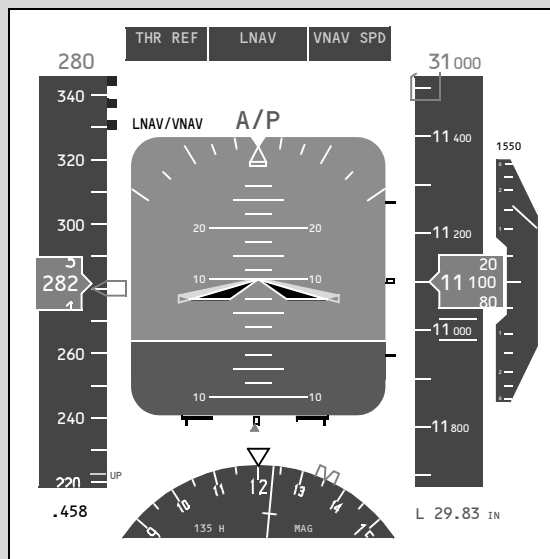
[Option - Split Cue Flight Director, Nav Perf]



[Option - AOA Indication, Nav Perf]

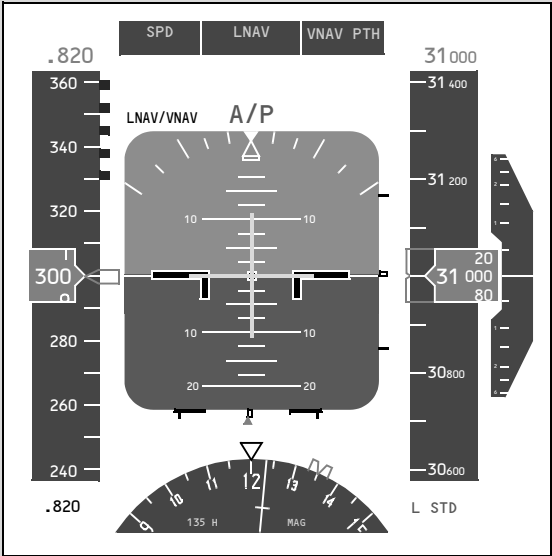


[Option - Integrated Cue Flight Director, Nav Perf]



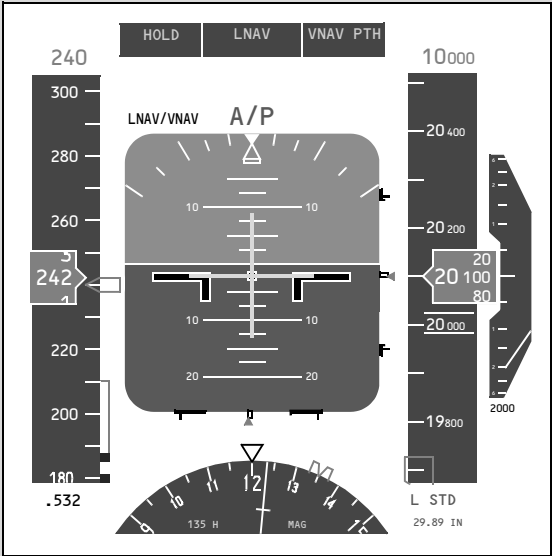
PFD Cruise Display

[Option – Split Cue Flight Director, Nav Perf]

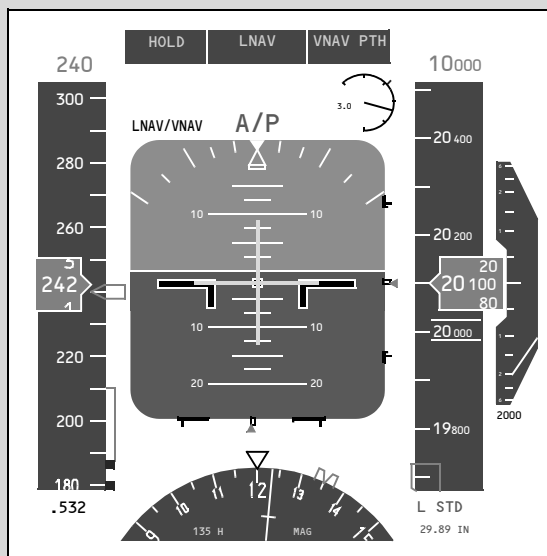


PFD Descent Display

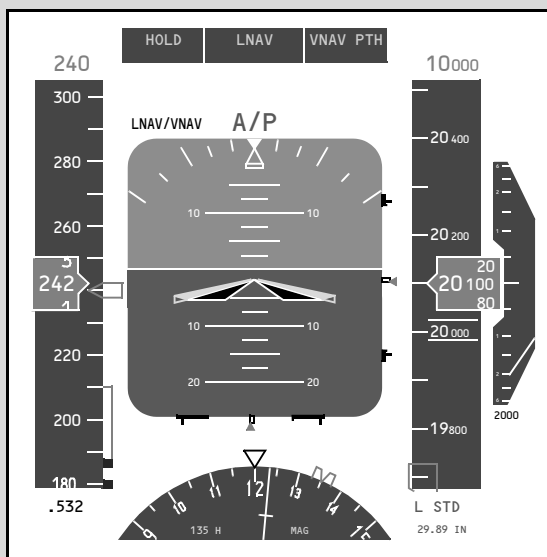
[Option – Split Cue Flight Director, Nav Perf]



[Option – AOA Indication, Nav Perf]

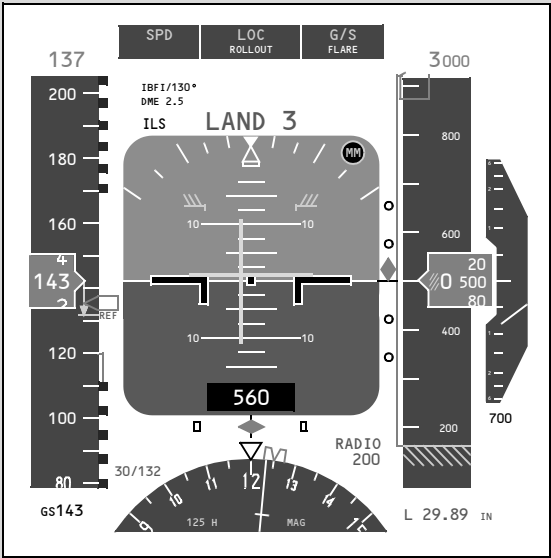


[Option - Integrated Cue Flight Director, Nav Perf]

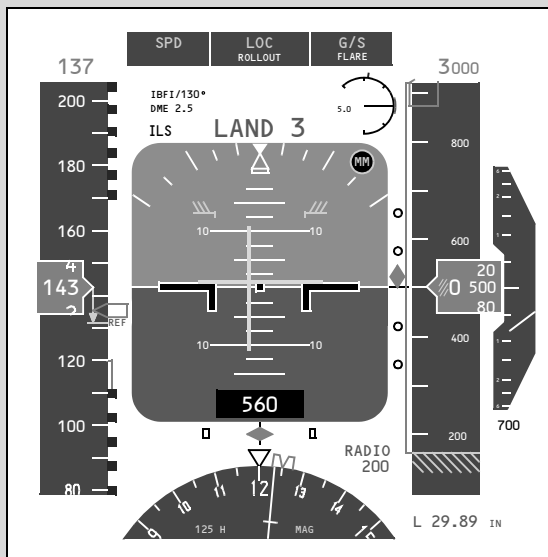


PFD Approach Display

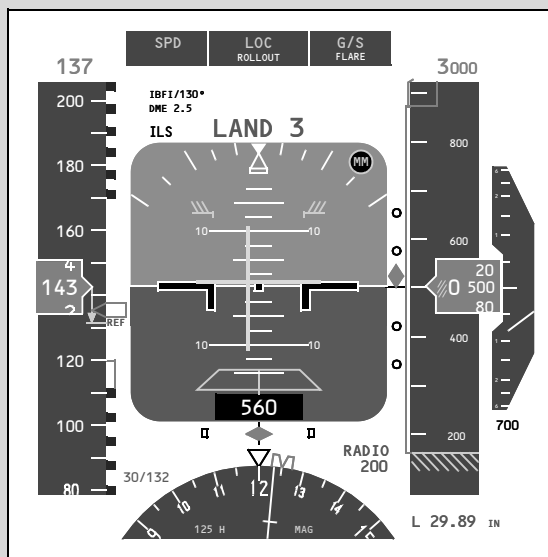
[Option - Ground Speed Display, Nav Perf]



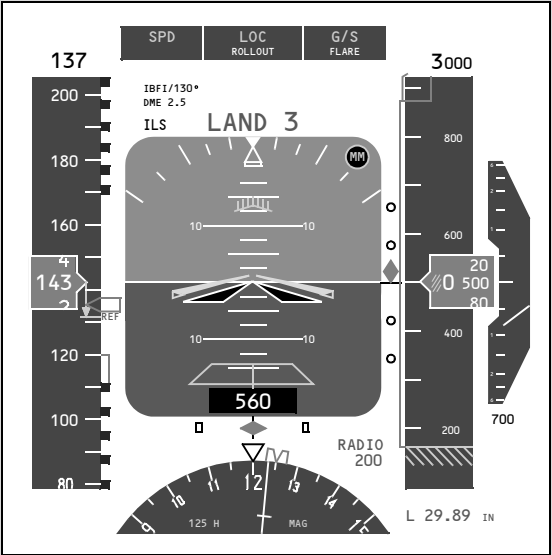
[Option – AOA Indication, Nav Perf]



[Options – Basic, Split Cue Flight Director, Numeric RA Display, Landing Altitude Reference Bar, Rising Runway, Nav Perf]

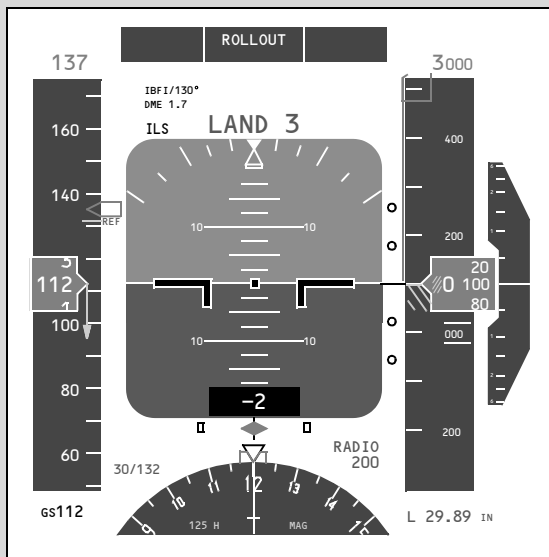


[Option - Integrated Cue Flight Director, Numeric RA Display, Landing Altitude Reference Bar, Rising Runway, Nav Perf]

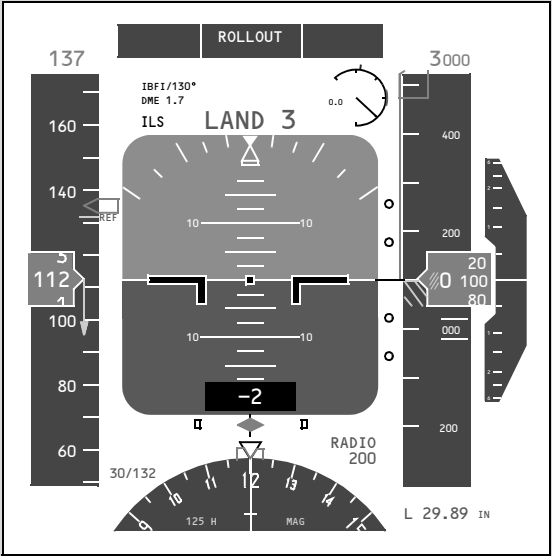


PFD Landing Display

[Option - Ground Speed Display, Nav Perf]

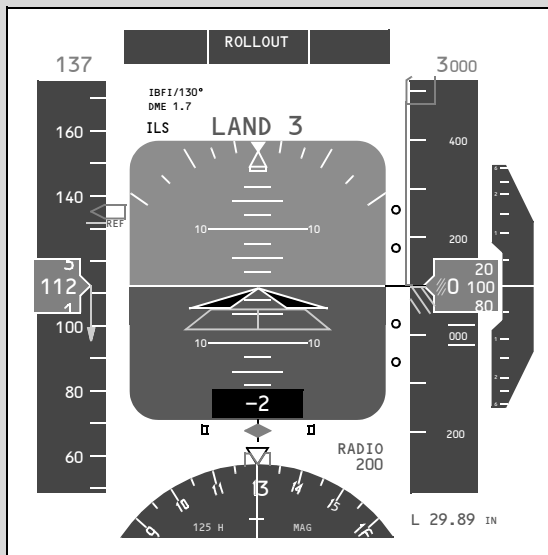


[Option - AOA Indication, Nav Perf]



777 Flight Crew Operations Manual

[Option - Integrated Cue Flight Director, Numeric RA Display, Landing Altitude Reference Bar, Rising Runway, Nav Perf]



Intentionally
Blank

Flight Instruments, Displays

Navigation Displays

Chapter 10

Section 40

Introduction

The NDs provide a mode-selectable color flight progress display. The modes are:

- MAP
- VOR
- APP (approach)
- PLN (plan).

The MAP, VOR, and APP modes can be switched between an expanded mode with a partial compass rose and a centered mode with a full compass rose.

Map Mode

The MAP mode is recommended for most phases of flight.

[Option – Track-Up Display]

Presented track up, this mode shows airplane position relative to the route of flight against a moving map background.

[Option – Heading-Up Display]

Presented heading up, this mode shows airplane position relative to the route of flight against a moving map background.

Displayed information can include:

- selected and current track
- selected and current heading
- position trend vector
- range to selected altitude
- map range scale
- ground speed
- true airspeed
- wind direction and speed
- next waypoint distance
- waypoint estimated time of arrival
- selected navigation data points.

Navigation Data Points

Additional navigation facility (STA), waypoint (WPT), airport (ARPT), route progress (DATA) and position (POS) data are available for display on the ND in both the expanded and center map modes.

VOR and Approach Modes

The VOR and APP modes are presented heading up. The VOR and APP modes display track, heading, and wind speed and direction with VOR navigation or ILS approach information.

Plan Mode

The PLN mode is presented true north up. The active route may be viewed using the STEP prompt on the CDU LEGS pages.

ND Information

Heading

Heading is supplied by the FMC or air data inertial reference system (ADIRS). The ND compass rose can be referenced to magnetic north or true north. The heading reference switch is used to manually select magnetic or true reference. The compass display is automatically referenced to true north when the airplane is north of 82° north or south of 82° south latitude, or near the magnetic poles with the heading reference switch in NORM.

Track

Track is supplied by the FMC during normal operation and by the CDU when in alternate navigation.

Traffic

Traffic information from the TCAS can be displayed on the ND. TCAS is described in Chapter 15, Warning Systems.

Weather Radar

Weather radar information can be displayed on the ND. The weather radar system is described in Chapter 11, Flight Management, Navigation.

Failure Flags and Messages

Failure flags are displayed for system failures or invalid information. Indications are removed or replaced by dashes when source system information is not available.

The message EXCESS DATA is displayed if the amount of information sent to the ND exceeds the display capability. When this occurs, the primary display system removes information from the center of the display outward; information near the outer selected range area is still displayed. The message can be removed by:

- reducing the amount of map information
- reducing range, or
- deselecting one or more of the EFIS control panel map switches (STA, WPT, ARPT, DATA, POS).

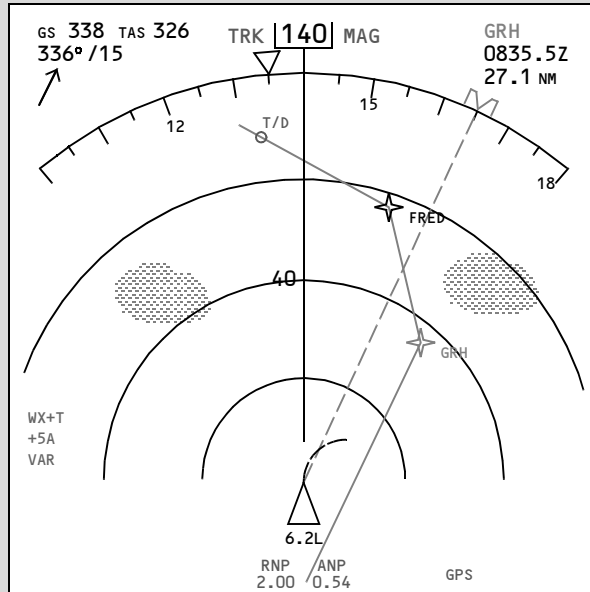
Typical ND Map Displays

Typical ND map displays are shown on the following pages. Examples of other ND displays (centered map, approach, VOR, and plan modes) are shown in Section 10 of this chapter.

ND Expanded Map Displays

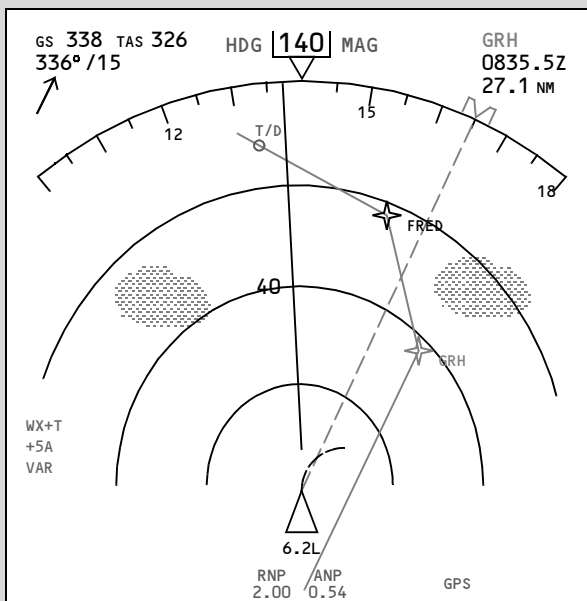
[Option – Track-Up Display, Basic Radar, autotilt, Nav Perf]

WXR
(weather
radar) map
switch
selected.



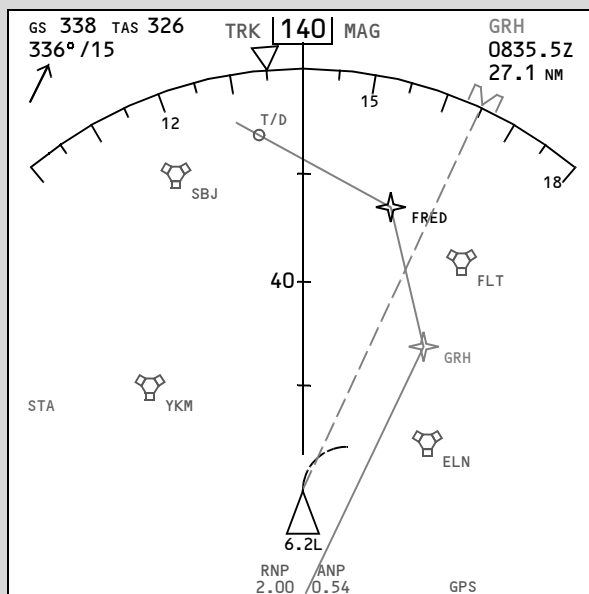
[Option – Heading–Up Display, Basic Radar, autotilt, Nav Perf]

WXR
(weather
radar) map
switch
selected.



[Option – Track–Up Display, Nav Perf]

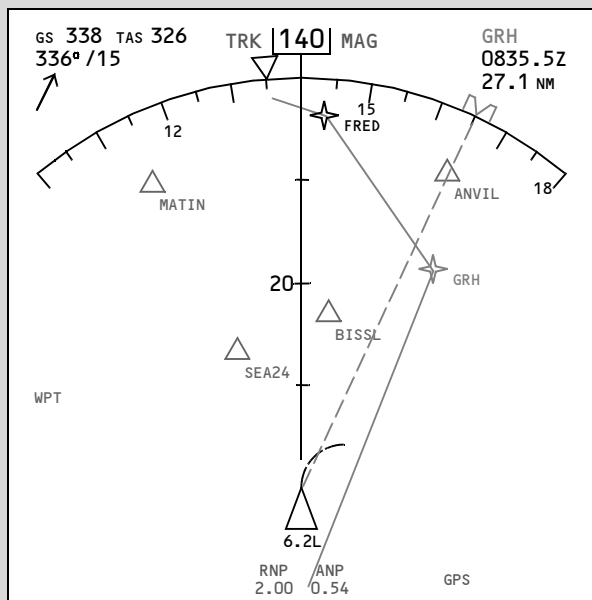
STA
(station)
map
switch
selected.



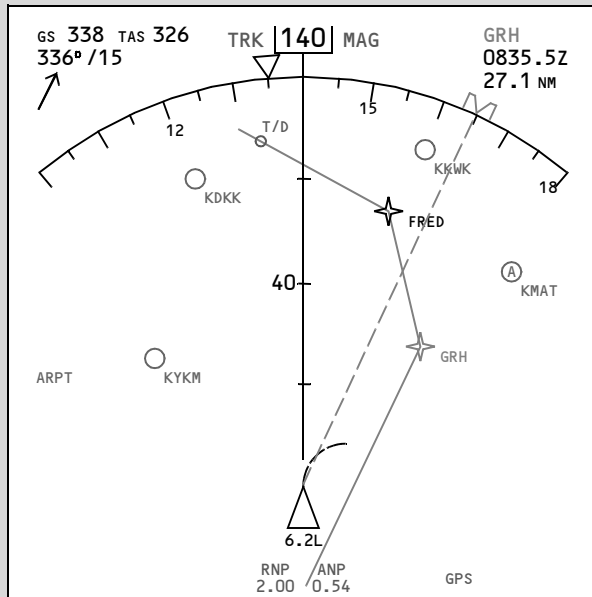
[illegible]

[Option – Track-Up Display, Nav Perf]

WPT
(waypoint)
map switch
selected.



ARPT
(airport)
map switch
selected.



GS 338 TAS 326
336°/15

HGD 140 MAG

GRH 0835.5Z
27.1 NM

12 15 18

MATIN

20

SEA24

BISSL

FRED

ANVIL

GRH

6.2L

WPT

RNP 2.00 ANP 0.54

GPS

GS 338 TAS 326
336°/15

HDG 140 MAG

GRH 0835.5Z
27.1 NM

T/O

KDKK

KYKM

ARPT

6.2L

RNP 2.00 ANP 0.54

FRED

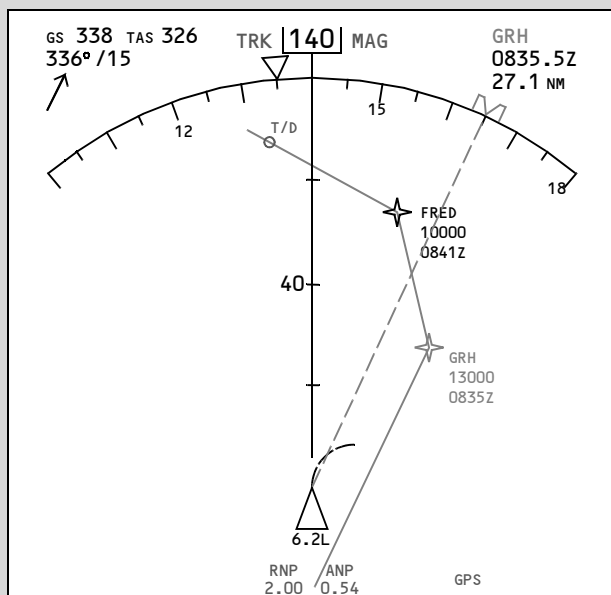
GRH

KMAT

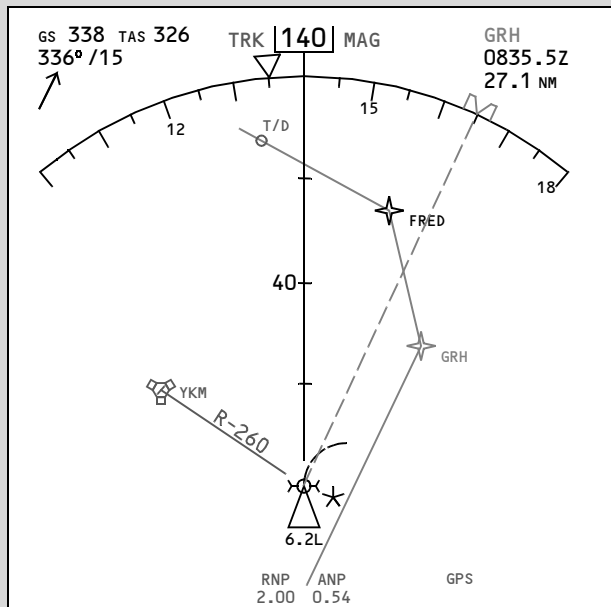
GPS

[Option – Track-Up Display, Nav Perf]

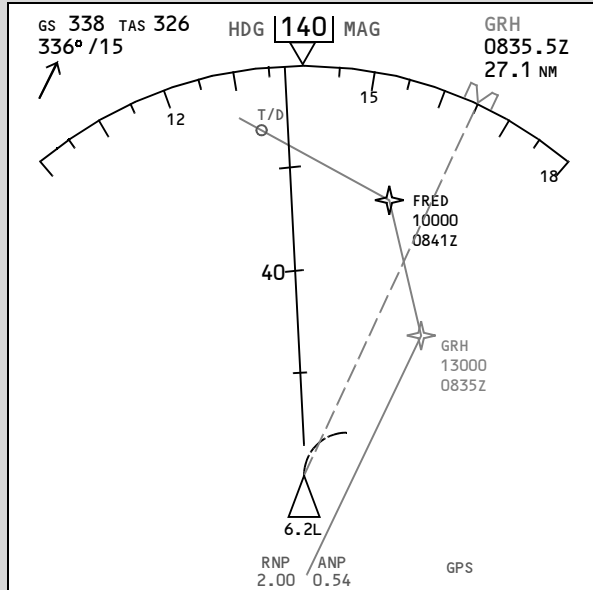
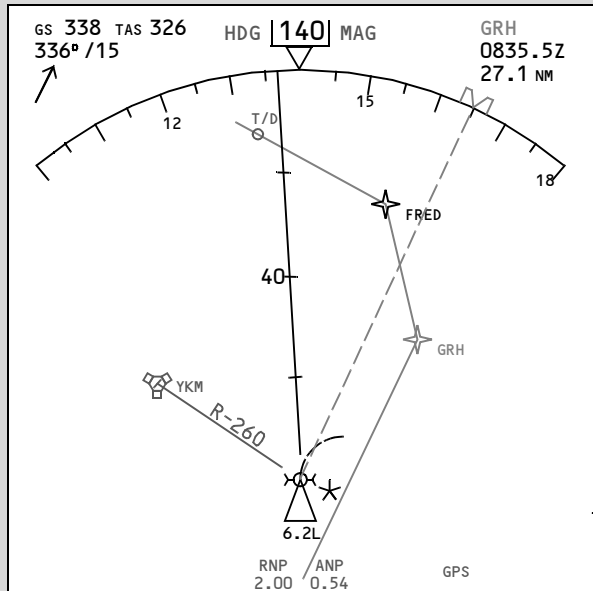
DATA map
switch
selected.



POS
(position)
map switch
selected.



[Option – Heading-Up Display, Nav Perf]

DATA map
switch selected.**POS**
(position)
map switch
selected.

ND Symbology

The following symbols can be displayed on each ND, depending on EFIS control panel switch selections. Colors indicate the following:

- W (white) – present status, range scales
- G (green) – dynamic conditions
- M (magenta) – command information, pointers, symbols, fly-to condition
- B (blue or cyan) – inactive or background information
- A (amber or yellow) – cautions, faults, flags
- R (red) – warnings.

Heading, Track, and Speed

Symbol	Name	ND Mode	Remarks
--------	------	---------	---------

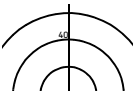
[Option - Map Track Up]

TRK  MAG	Track orientation (G), current track (W), and track reference (G)	Shows track in MAP, MAP CTR.	Displays TRK as the orientation, the current track, and MAG or TRU as the reference, and points to the heading on the compass rose.
HDG  MAG	Heading orientation (G), current heading (W), heading reference (G), and heading pointer (W)	Shows HDG (heading) in VOR, VOR CTR, APP, APP CTR	Displays HDG as the display orientation, current heading, MAG or TRU as the heading reference, and points to the heading on the compass rose.

[Option - Grid Heading]

	Grid heading (W)	MAP, MAP CTR, PLAN	Displays above 70 degrees latitude.
TIME TO ALIGN 05:35	ADIRU time to align (W)	All	Indicates time remaining for IRU alignment. Replaces wind direction/speed and wind arrow, on the ground, during alignment.

777 Flight Crew Operations Manual

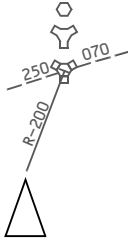
Symbol	Name	ND Mode	Remarks
	Selected heading bug (M)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Displays the MCP–selected heading. A dashed line (M) may extend from the marker to the airplane symbol. In the MAP mode with LNAV, LOC, or ROLLOUT engaged, the dashed line is removed 10 seconds after the selected heading bug is moved.
	Selected track bug (M)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Displays the MCP–selected track. A dashed line (M) may extend from the marker to the airplane symbol.
	Track line and range scale (W)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Indicates current track. Number indicates range (VOR CTR and APP CTR do not display range).
	Range arcs (W)	MAP, MAP CTR, VOR CTR, APP CTR	Replaces the range scale when TCAS, weather radar, or terrain is selected.
	Heading/track reference (G) box (W) in TRU, box (A) if TRU displayed in descent	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Indicates heading/track is referenced to magnetic north or true north. Switching from TRU to MAG displays a box around MAG for 10 seconds.
	Expanded compass (W)	MAP, APP, VOR	Displays 90 degrees of compass rose.
	Current heading pointer (W)	MAP, MAP CTR	Points to current heading on the compass rose.
gs 310	Groundspeed (W)	All	Current ground speed.

Symbol	Name	ND Mode	Remarks
TAS312	True airspeed (W)	All	Current true airspeed displayed above 100 knots.
350°/15 ↙	Wind direction/ speed and wind arrow (W)	All	Indicates wind bearing, speed, and direction, with respect to display orientation and heading/track reference. Arrow not displayed in the PLAN map mode.

Radio Navigation

Symbol	Name	ND Mode	Remarks
VOR L, R ILS L, C, R	Reference receiver (G)	VOR, VOR CTR, APP, APP CTR	Indicates the selected receiver as the display reference.
116.80 OR SEA	ILS (W)/VOR (W) Reference receiver frequency or identifier display	VOR, VOR CTR, APP, APP CTR	Located in the upper corner. Frequency displayed before the identifier is decoded. The decoded identifier replaces the frequency. Medium size characters for VOR, small size characters for DME only.
DME 24.6	DME distance (W)	VOR, VOR CTR, APP, APP CTR	Located in the upper corner. Indicates DME distance to the reference navaid.
CRS 135	Reference ILS or VOR course (W)	VOR, VOR CTR, APP, APP CTR	Indicates the VOR course or ILS localizer course.
○ ○ ○ ○	ILS localizer or VOR course deviation indication (M) and scale (W)	VOR, VOR CTR, APP, APP CTR	Displays LOC or VOR course deviation. Deviation indicator points in direction of VOR or ILS selected course. For ILS deviation, indicator fills (M) when less than 2 1/2 dots from center.

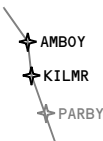
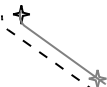
777 Flight Crew Operations Manual

Symbol	Name	ND Mode	Remarks
	Selected course pointer (W) and line (M)	VOR, VOR CTR, APP, APP CTR	Displays CDU–selected course.
	Glide slope pointer (M) and scale (W)	APP, APP CTR	Displays glideslope position and deviation. Deviation indicator fills (M) when less than 2 1/2 dots from center.
	To/from indication (W)	VOR CTR	Located near airplane symbol. Displays VOR TO/FROM indication.
TO FROM	To/from indication (W)	VOR, VOR CTR	Displays VOR to/from indication.
	VOR (B, G), DME/TACAN (B, G), VORTAC (B, G)	MAP, MAP CTR	When the EFIS control panel STA map switch is selected on, appropriate nav aids are displayed (B). Tuned VHF nav aids are displayed in green, regardless of switch selection. When a nav aid is manually tuned, the selected course and reciprocal are displayed.
	VOR/DME raw data radial and distance (G)		When the POS map switch is selected on, the station radial extends to the airplane.
	Left VOR (G) or ADF (B) pointer head and tail	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Indicates bearing to (head) or from (tail) the tuned station, if selected on the respective EFIS control panel.
	Right VOR (G) or ADF (B) pointer head and tail		

Symbol	Name	ND Mode	Remarks
	Left VOR (G) pointer head and tail	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Indicates bearing to (head) or from (tail) the tuned station, if selected on the respective EFIS control panel.
	Right VOR (G) pointer head and tail		
VOR L, R	VOR (G) selection	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Located lower left or right corner. Represents VOR position of the EFIS control panel VOR/ADF switches.
ADF L, R	ADF (B) selection	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Located lower left or right corner. Represents ADF position of the EFIS control panel VOR/ADF switches.
INOP	INOP (W) selection	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Represents INOP position of the EFIS control panel VOR/INOP switches.
116.80 OR SEA	VOR frequency or identifier (G)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Located lower left or right corner. Frequency is displayed before identifier is decoded. Decoded identifier replaces the frequency. Small size characters indicate only DME information is being received.
520 OR BF	ADF frequency or identifier (B)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Located lower left or right corner. Frequency is displayed before identifier is decoded. Decoded identifier replaces the frequency.
DME 24.6	DME distance (G)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Located in the lower corners. Indicates DME distance to the referenced navaid.

Map

Symbol	Name	ND Mode	Remarks
	Airplane symbol (W)	MAP, MAP CTR, VOR, APP	Current airplane position is at the apex of the triangle.
	Airplane symbol (W)	VOR CTR, APP CTR	Current airplane position is at the center of the symbol.
	Position trend vector (W) (dashed line)	MAP, MAP CTR	Predicts position at the end of 30, 60, and 90 second intervals. Each segment represents 30 seconds. Based on bank angle and ground speed. Selected range determines the number of segments displayed. For range: • greater than 20 NM, 3 segments • = 20 NM, 2 segments • = 10 NM, 1 segment.
	Airplane symbol (W)	PLAN	Indicates actual position and track along the flight plan route in plan mode only. Inhibited north of 82N latitude and south of 82S latitude.
ABCDE	Active waypoint identifier (M)	MAP, MAP CTR, PLAN	Indicates the active flight plan waypoint, the next waypoint on the route of flight.
124 NM	Active waypoint distance (W)	MAP, MAP CTR, PLAN	Distance to the active waypoint.
0025 TTG	Active waypoint time to go during alternate navigation (W)	MAP, MAP CTR, PLAN	Indicates CDU calculated time to go in hours and minutes to active waypoint during alternate navigation.

Symbol	Name	ND Mode	Remarks
0835.4z	Active waypoint ETA (W)	MAP, MAP CTR, PLAN	Indicates ETA at the active waypoint. Time is based on distance to go and ground speed. It does not consider FMC performance predictions and may differ from other FMC ETAs that do.
	Waypoint: active (M), inactive (W)	MAP, MAP CTR, PLAN	Active – represents the waypoint the airplane is currently navigating to. Inactive – represents the waypoints on the active route.
	Off route waypoint (B)	MAP, MAP CTR	When the EFIS control panel WPT map switch is selected on, waypoints not on the selected route are displayed, in ND ranges of 10, 20, or 40.
	Flight plan route: active (M), modified (W), inactive (B)	MAP, MAP CTR, PLAN	The active route is displayed with a continuous line (M) between waypoints. Active route modifications are displayed with short dashes (W) between waypoints. Inactive routes are displayed with long dashes (B) between waypoints.
	Offset path and identifier: active route (M), modified route (W)	MAP, MAP CTR, PLAN	Presents a dashed line parallel to and offset from the active or modified route.

777 Flight Crew Operations Manual

Symbol	Name	ND Mode	Remarks
	Route data: active waypoint (M), inactive waypoint (W)	MAP, MAP CTR	When the EFIS control panel DATA map switch is selected on, entered or procedural altitude and ETAs for route waypoints are displayed. Times consider FMC performance predictions and wind data.
	Altitude range arc (G)	MAP, MAP CTR	Based on vertical speed and groundspeed, indicates the approximate map position where the MCP altitude will be reached.
	Altitude profile point and identifier (G)	MAP, MAP CTR	Indicates the approximate map position of the FMC-calculated T/C (top-of-climb), T/D (top-of-descent), S/C (step climb), and E/D (end of descent) points. Predicted altitude/ETA points entered on the FIX page display the altitude/ETA along with the profile point. Deceleration points have no identifier.
	VNAV path pointer (M) deviation scale (W) digital vertical path deviation (W) vertical path deviation band (M)	MAP, MAP CTR	Displays vertical deviation from selected VNAV PATH during descent only. Scale indicates ± 400 feet deviation. Digital display is provided when the pointer indicates more than ± 20 feet.
	Airport and runway (W)	MAP, MAP CTR, PLAN	Displayed when selected as the origin or destination and ND range is 80, 160, 320, or 640 NM.

Symbol	Name	ND Mode	Remarks
	Airport (B)	MAP, MAP CTR, PLAN	Displayed if the EFIS control panel ARPT map switch is selected on. Origin and destination airports are always displayed, regardless of map switch selection.
	Airport and runway (W)	MAP, MAP CTR, PLAN	Displayed when selected as the origin or destination and ND range is 10, 20, or 40 NM. Dashed runway centerlines extend 14.2 NM.
	Energy management circles (B, W)	MAP, MAP CTR	Indicates clean (B) and speedbrake (W) energy management circles as defined on the CDU OFFPATH DES page.
	Selected reference point and bearing distance information (G)	MAP, MAP CTR, PLAN	Displays the reference point selected on the CDU FIX page. Bearing and/or distance from the fix are displayed with dashes (G).
GPS DME-DME VOR-DME LOC LOC-GPS LOC-DME-DME LOC-VOR-DME INERTIAL	FMC position update status (G)	MAP, MAP CTR	Indicates the system providing FMC position update.
	GPS position (W)	MAP, MAP CTR	When the EFIS POS map switch is selected on, indicates GPS position relative to FMC position.
★	ADIRU position (W)	MAP, MAP CTR	When the EFIS control panel POS map switch is selected on, the star indicates ADIRU position relative to FMC position.

777 Flight Crew Operations Manual

Symbol	Name	ND Mode	Remarks
	Weather radar returns (R, A, G, M)	MAP, MAP CTR, VOR, APP	The most intense areas are displayed in red, lesser intensity in amber, and lowest intensity green. Turbulence is displayed in magenta.
STA WPT ARPT	Selected map options (B)	MAP, MAP CTR	Displays EFIS control panel selected map options.
N↑	North up arrow (G)	PLAN	Indicates map background is oriented and referenced to true north.
CDU L, C, R	Map source annunciation (G)	MAP, MAP CTR	Displays ND source if: • CDU is selected on respective navigation source select switch • both FMCs fail, or • a manually selected FMC fails.

[\[AIMS 2003\]](#)

	Holding pattern: active route (M), modified route (W), inactive route (B)	MAP, MAP CTR, PLAN	A holding pattern appears when in the flight plan. Depicts entry path until entry completed.
	Procedure turn: active route (M), modified route (W), inactive route (B)	MAP, MAP CTR, PLAN	A procedure turn appears when in the flight plan. It increases in size upon entering the procedure turn. Also used for procedure hold course reversal.

Symbol	Name	ND Mode	Remarks
--------	------	---------	---------

[AIMS 2003]

 	Alternate airports (B)	MAP, MAP CTR, PLAN	PLAN: displays up to four alternate airports at all times. MAP, MAP CTR: displays the FMC or pilot selected primary alternate airport. Displays up to four alternate airports when the EFIS control panel APRT map switch is selected on. Offscale airports (those beyond 640NM with 640 scale selected), directional arrow relative to airplane position or PLAN center point and distance (distance removed in PLAN).
--	------------------------	--------------------	---

TCAS

Refer to Chapter 15, Warning systems for more information.

Symbol	Name	ND Mode
	TCAS resolution advisory (RA), relative altitude (R)	MAP, MAP CTR, APP, VOR
	TCAS traffic advisory (TA), relative altitude (A)	MAP, MAP CTR, APP, VOR
	TCAS proximate traffic, relative altitude (W)	MAP, MAP CTR, APP, VOR
	TCAS other traffic, relative altitude (W)	MAP, MAP CTR, APP, VOR
	TCAS TA, absolute altitude	MAP, MAP CTR, APP, VOR
RA 5.3 +03 ↑ TA 8.9 -12 ↑	TCAS no bearing message (RA-R, TA-A)	MAP, MAP CTR, APP, VOR

777 Flight Crew Operations Manual

Symbol	Name	ND Mode
TRAFFIC	TCAS traffic alert message (RA–R, TA–A)	All
OFFSCALE	TCAS off scale message (RA–R, TA–A)	MAP, MAP CTR, APP, VOR
TFC	TCAS mode (B)	MAP, MAP CTR, APP, VOR
TA ONLY	TCAS mode (B)	All
TCAS TEST	TCAS mode (B)	All
TCAS OFF	TCAS mode (A)	MAP, MAP CTR, APP, VOR
TCAS FAIL	TCAS mode (A)	MAP, MAP CTR, APP, VOR

Radar**[Typical]**

Refer to Chapter 11, Flight Management, Navigation for more information.

Symbol	Name	ND Mode
TEST	Weather radar test mode (B) (A)	MAP, MAP CTR, APP, VOR
WXR	Precipitation only mode (B)	MAP, MAP CTR, APP, VOR
WX+T	WXR and turbulence mode (B)	MAP, MAP CTR, APP, VOR
VAR	WXR receiver gain (B)	MAP, MAP CTR, APP, VOR
MAP	Mode used with down–tilt, when ground mapping (B)	MAP, MAP CTR, APP, VOR
+5A	WXR antenna automatic tilt mode selected (B)	MAP, MAP CTR, APP, VOR
+5M	WXR antenna manual tilt mode selected (B)	MAP, MAP CTR, APP, VOR
WXR FAIL	WXR system failure (A)	MAP, MAP CTR, APP, VOR

Symbol	Name	ND Mode
RT	WXR receiver transmitter failure (A)	MAP, MAP CTR, APP, VOR
ANT	WXR antenna fault (A)	MAP, MAP CTR, APP, VOR
AUTOTILT FAIL	Automatic tilt mode failure (A)	MAP, MAP CTR, APP, VOR
CONT	WXR control panel failure (A)	MAP, MAP CTR, APP, VOR
ATT	WXR loss of attitude data (A)	MAP, MAP CTR, APP, VOR
WEAK	WXR calibration fault (A)	MAP, MAP CTR, APP, VOR

Look-Ahead Terrain

Refer to Chapter 15, Warning systems for more information.

Symbol	Name	ND Mode
	Obstacle display (R, A, G)	MAP, MAP CTR, APP, VOR
	Terrain display (R, A, G, M)	MAP, MAP CTR, APP, VOR
OBSTACLE	Obstacle annunciation (R, A)	All
TERR 060 030	Terrain mode annunciation (C) and highest and lowest terrain or obstacle altitudes (R, A, G, M)	MAP, MAP CTR, APP, VOR
TERR TEST	Terrain test mode annunciation (C)	All
TERRAIN	Terrain annunciation (R, A)	All

777 Flight Crew Operations Manual

Symbol	Name	ND Mode
TERR FAIL	Terrain status annunciation (A)	MAP, MAP CTR, APP, VOR
TERR POS	Terrain status annunciation (A)	MAP, MAP CTR, APP, VOR
TERR OVRD	Terrain status annunciation (A)	MAP, MAP CTR, APP, VOR
TERR RANGE DISAGREE	Terrain range status annunciation (A)	MAP, MAP CTR, APP, VOR
MAP/TERR RANGE DISAGREE	Terrain range status annunciation (A)	MAP, MAP CTR

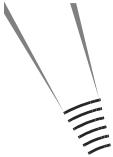
Runway Awareness and Advisory System

Refer to Chapter 15, Warning systems for more information.

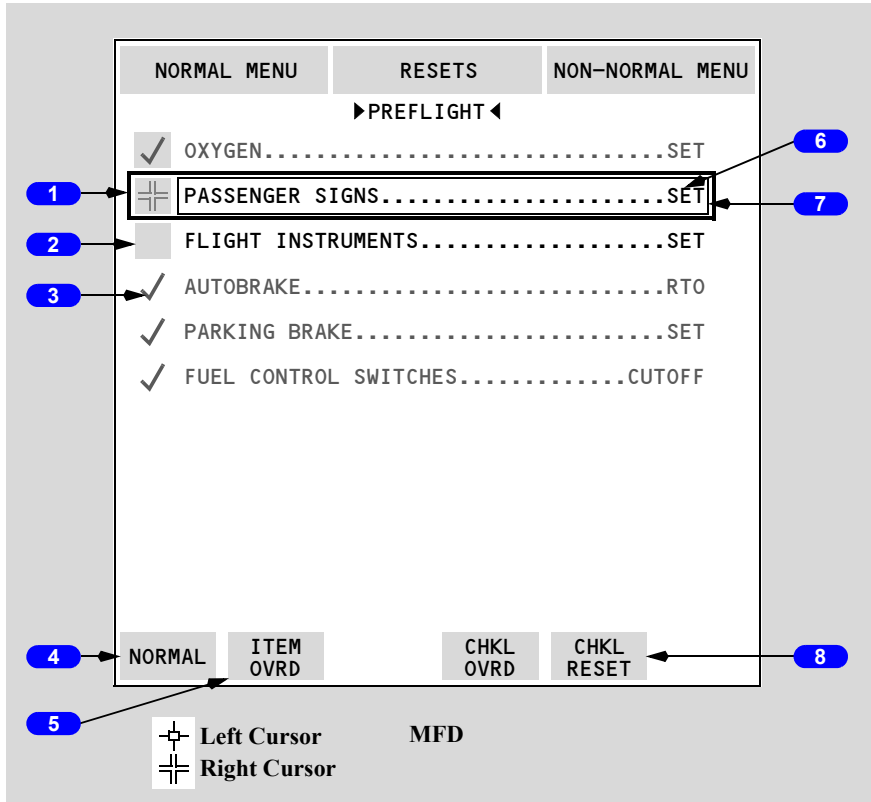
Symbol	Name	ND Mode
ON TAXIWAY	On Taxiway caution alert(A)	MAP, MAP CTR, VOR, APP
SHORT RUNWAY	Short Runway caution alert (A)	MAP, MAP CTR, VOR, APP

Predictive Windshear

Refer to Chapter 15, Warning systems for more information.

Symbol	Name	ND Mode
	Predictive windshear symbol (R, B, A)	MAP, MAP CTR, APP, VOR
WINDSHEAR	Windshear annunciation (R, A)	All

Normal Checklist



1 Cursor Selection Box

Highlights cursor selection area.

2 Open Loop Indicator

Indicates line item is an open loop action item. Requires crew confirmation to become complete.

3 Complete Indicator

Indicates line item is complete.

4 Normal Checklist (NORMAL) Key

Select –

- displays next incomplete normal checklist
- displays normal checklists menu page when all normal checklists are complete.

5 Line Item Override (ITEM OVRD) Key

Select – overrides line item in current line item box. Item is displayed cyan.

6 Checklist Line Item

Displayed (white) –

- when action is required, line item is incomplete
- when action is not required, line item remains white and is complete.

Displayed (green) – line item is complete.

Displayed (cyan) – line item is inactive or overridden.

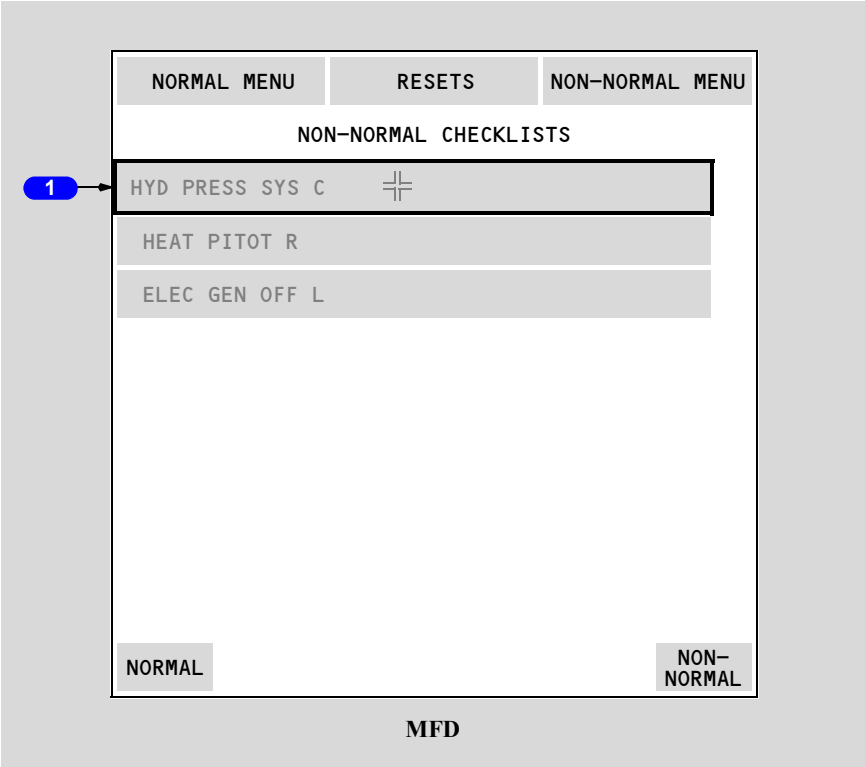
7 Current Line Item Box

Highlights current incomplete line item.

8 Checklist Reset (CHKL RESET) Key

Select – resets displayed checklist. All open loop line items become incomplete and current line item box, cursor selection box, and cursor move to first incomplete line item.

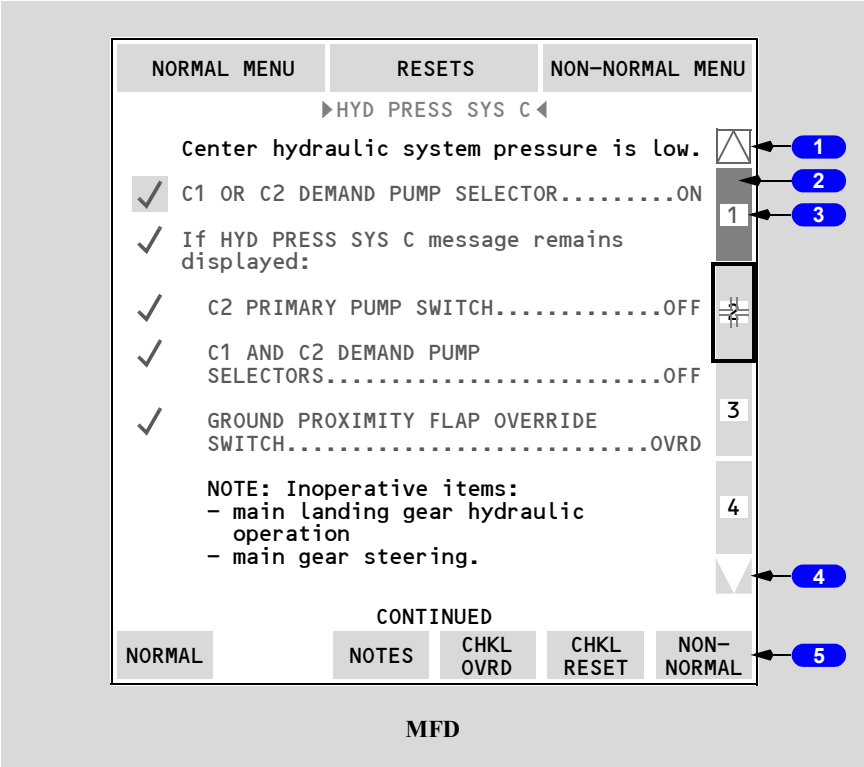
Non-Normal Checklist Queue



1 Checklist Key

Select – displays checklist corresponding to title on key.

Non-Normal Checklist



1 Previous Page Key

- Select – displays previous checklist page.
- Displayed (gray) – previous page is available.
- Displayed (cyan) – key is inactive. First page of checklist is displayed.

2 Checklist Page Key

- Select – displays checklist page corresponding to page number on key.
- Displayed (white) – checklist page corresponding to page number on key is currently displayed.
- Displayed (gray) – checklist page corresponding to page number on key is not currently displayed.

3 Checklist Page Number

- Displayed (white) – checklist page is incomplete.

Displayed (green) – checklist page is complete.

4 Next Page Key

Select – displays next checklist page.

Displayed (gray) – next page is available.

Displayed (cyan) – key is inactive. Last page of checklist is displayed.

5 Non-Normal Checklist (NON-NORMAL) Key

Displayed when additional incomplete non-normal checklists exist.

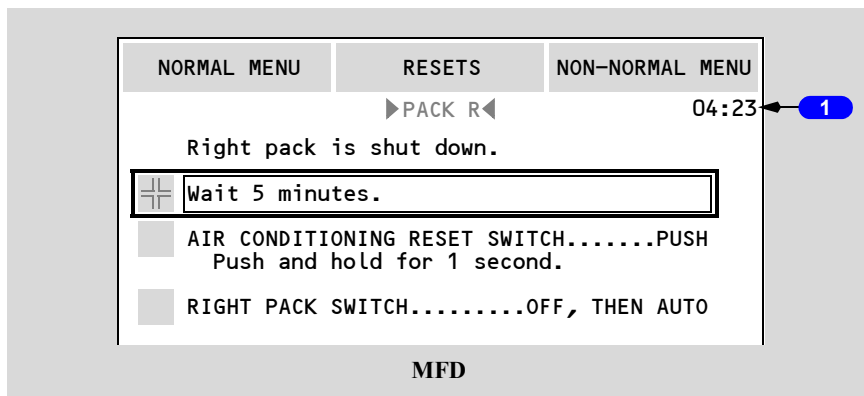
Select –

- displays next incomplete non-normal checklist when one incomplete non-normal checklist exists
- displays non-normal checklist queue when more than one incomplete non-normal checklist exists.

Displayed (white) – incomplete non-normal checklist has not been displayed.

Displayed (amber) – incomplete non-normal checklist has been displayed but is not currently displayed.

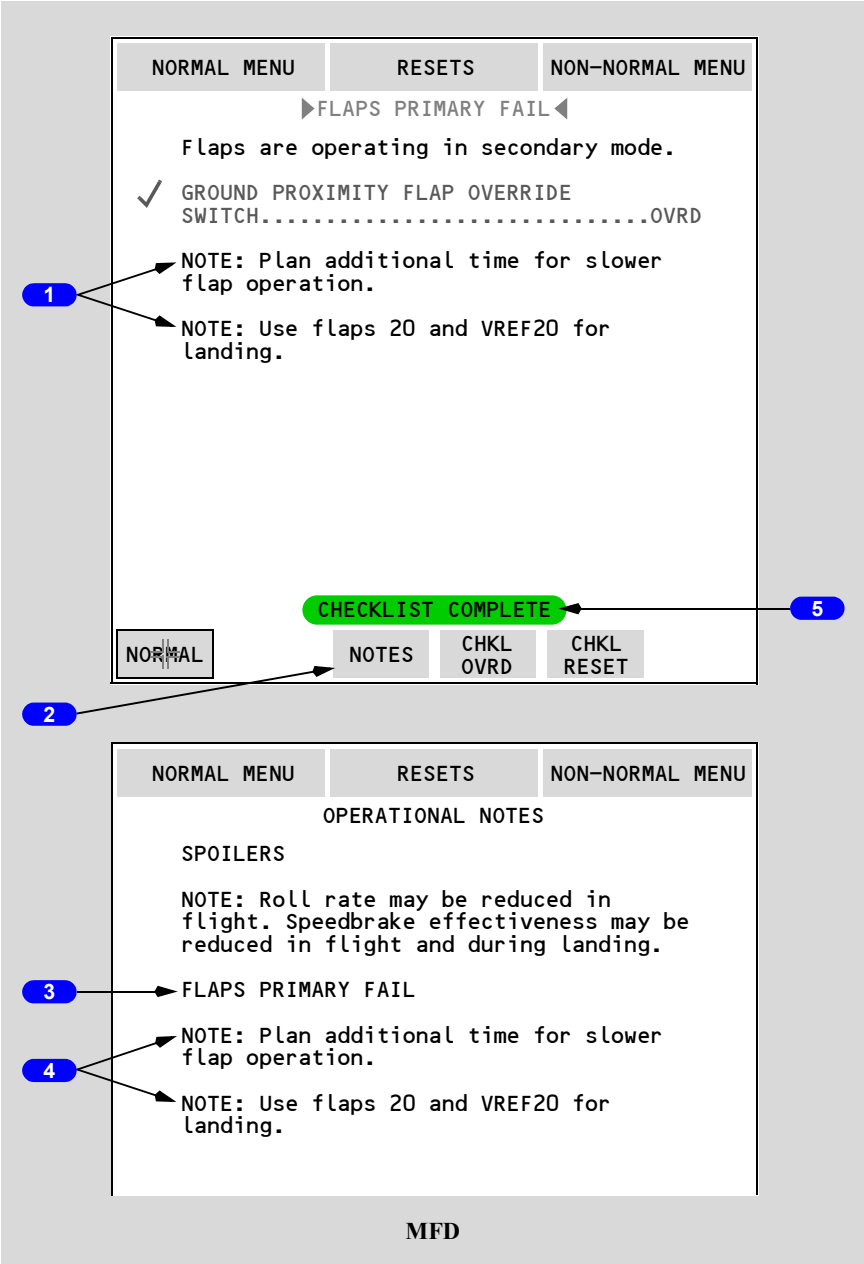
Checklist Timer



1 Timer

Displays time remaining of time delay associated with line item in current line item box. If line item is complete, current line item box remains until timer expires.

Operational Note



1 Operational Notes

Shown in non-normal checklist.

2 Operational Notes (NOTES) Key

Select – displays operational notes page.

3 Checklist Reference

References non-normal checklist from which operational notes originated.

4 Operational Notes

Shown on operational notes page.

5 CHECKLIST COMPLETE Indicator

Displayed when all line items are either complete, inactive, or overridden, and all pages have been displayed.

Conditional Line Item

NORMAL MENU

RESETS

NON-NORMAL MENU

▶DET FIRE APU◀

APU fire detection is inoperative.

✓

If APU not running:

NOTE: Do not start the APU unless use is required.

✓

If APU is running:

✚

Plan to shut down the APU as soon as practical.

1

NORMAL MENU

RESETS

NON-NORMAL MENU

▶FLAPS DRIVE◀

✓

Flap position between 1 and 5 or at 5:

◆

YES

◆

NO

NOTE: Use current flaps and VREF30 + 40 for landing.

Flap position between 5 and 20:

◆

YES

✚

◆

NO

NOTE: Use current flaps and VREF30 + 20 for landing.

CONTINUED

NORMAL

NOTES

CHKL OVRD

CHKL RESET

2

1
2
3

MFD

1 Closed Loop Conditional Line Items

Displayed (cyan) – conditional line item is sensed false. All subsequent line items associated with the conditional line item become inactive and are displayed cyan. Current line item box, cursor selection box, and cursor skip inactive items and move to next incomplete line item.

Displayed (green) – conditional line item is sensed true. Current line item box, cursor selection box, and cursor move to next incomplete line item.

2 Open Loop Conditional Line Items

Displayed (cyan) – conditional line item is selected NO. All subsequent line items associated with the conditional line item become inactive and are displayed cyan. Current line item box, cursor selection box, and cursor skip inactive items and move to next incomplete line item.

Displayed (green) – conditional line item is selected YES. Current line item box, cursor selection box, and cursor move to next incomplete line item.

Deferred Line Item

NORMAL MENU

RESETS

NON-NORMAL MENU

▶FLAP/SLAT CONTROL◀

NOTE: Use flaps 20 and VREF20 for landing.

-----DEFERRED ITEMS-----

==> APPROACH CHECKLIST

ALTERNATE FLAPS ARM SWITCH.....ALTN

ALTERNATE FLAPS SELECTOR.....EXT
Monitor airspeed during extension.

CHECKLIST COMPLETE EXCEPT DEFERRED ITEMS

NORMAL

ITEM OVRD

NOTES

CHKL OVRD

CHKL RESET

1

2

3

4

1

2

NORMAL MENU

RESETS

NON-NORMAL MENU

▶APPROACH◀

✓

RECALL AND NOTES.....CHECKED

✓

AUTOBRAKE.....

✓

LANDING DATA.....SET

✓

ALTIMETERS.....SET

FLAP/SLAT CONTROL

ALTERNATE FLAPS ARM SWITCH.....ALTN

ALTERNATE FLAPS SELECTOR.....EXT
Monitor airspeed during extension.

5

6

MFD

1 Deferred Line Items Separator

Separates deferred line items from non-normal checklist line items. All line items below separator are deferred.

2 Checklist Reference

References normal checklist to which deferred line items are targeted.

3 Deferred Line Items

Shown in non-normal checklist.

4 CHECKLIST COMPLETE EXCEPT DEFERRED ITEMS Indicator

Displayed when all line items except deferred line items are either complete, inactive, or overridden, and all pages before the deferred line items separator have been displayed.

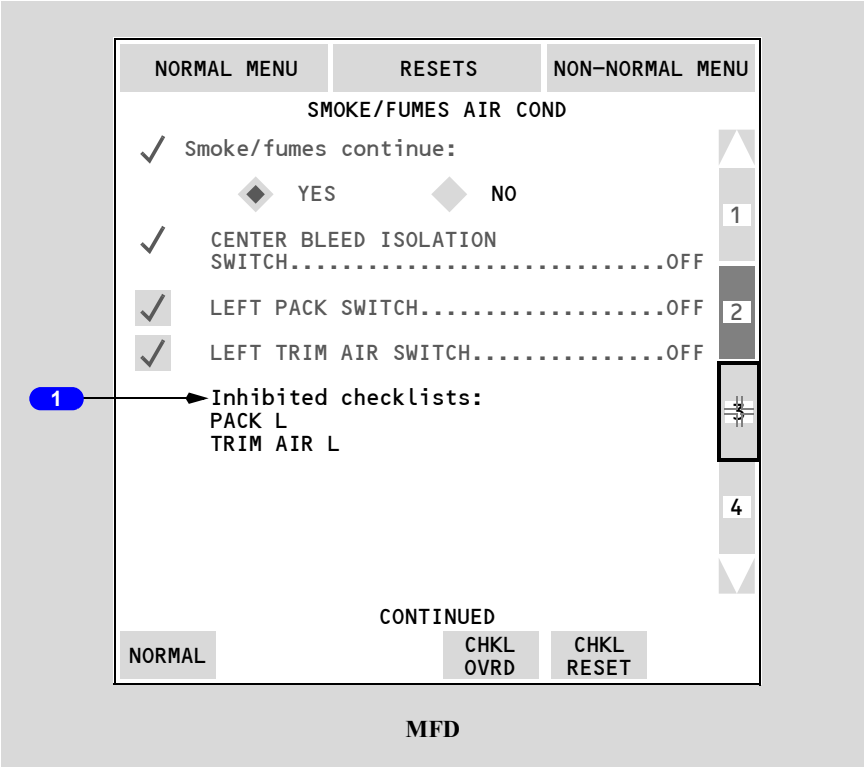
5 Checklist Reference

References non-normal checklist from which deferred line items originated.

6 Deferred Line Items

Shown in normal checklist.

Inhibit Checklist Line Item



1 Inhibit Checklist Line Item

Lists consequential checklists which are inhibited or removed from the checklist queue and whose corresponding checklist icons are inhibited or removed from display.

Checklist Override

NORMAL MENU

RESETS

NON-NORMAL MENU

▶HYD PRESS DEM L◀

Left demand pump output pressure is low when commanded on.

✚

LEFT DEMAND PUMP SELECTOR.....ON

If HYD PRESS DEM L message remains displayed:

LEFT DEMAND PUMP SELECTOR.....OFF

NORMAL

ITEM OVRD

CHKL OVRD

CHKL RESET

1

NORMAL MENU

RESETS

NON-NORMAL MENU

▶HYD PRESS DEM L◀

Left demand pump output pressure is low when commanded on.

LEFT DEMAND PUMP SELECTOR.....ON

If HYD PRESS DEM L message remains displayed:

LEFT DEMAND PUMP SELECTOR.....OFF

NORMAL

CHKL RESET

2

✚

CHECKLIST OVERRIDDEN

NORMAL

CHKL RESET

MFD

June 26, 2000

Copyright © The Boeing Company. See title page for details.

D632W001-TBC

10.50.13

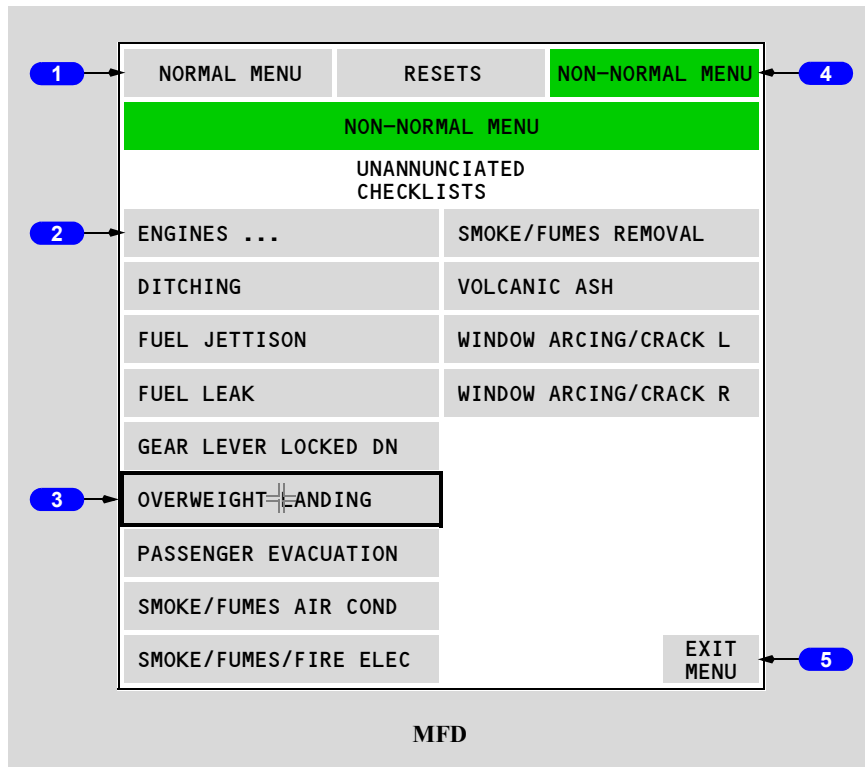
1 Checklist Override (CHKL OVRD) Key

Select – overrides displayed checklist.

2 CHECKLIST OVERRIDDEN Indicator

Displays when checklist is overridden. All line items are displayed cyan.

Checklists Menu Page



1 NORMAL MENU Key

Select – displays normal checklists menu page. Page contains checklist keys corresponding to the normal checklists.

2 Menu Key

Indicated by three dots following menu title.

Select – displays checklists menu page corresponding to title on key.

3 Checklist Key

Select – displays checklist corresponding to title on key.

4 NON-NORMAL MENU Key

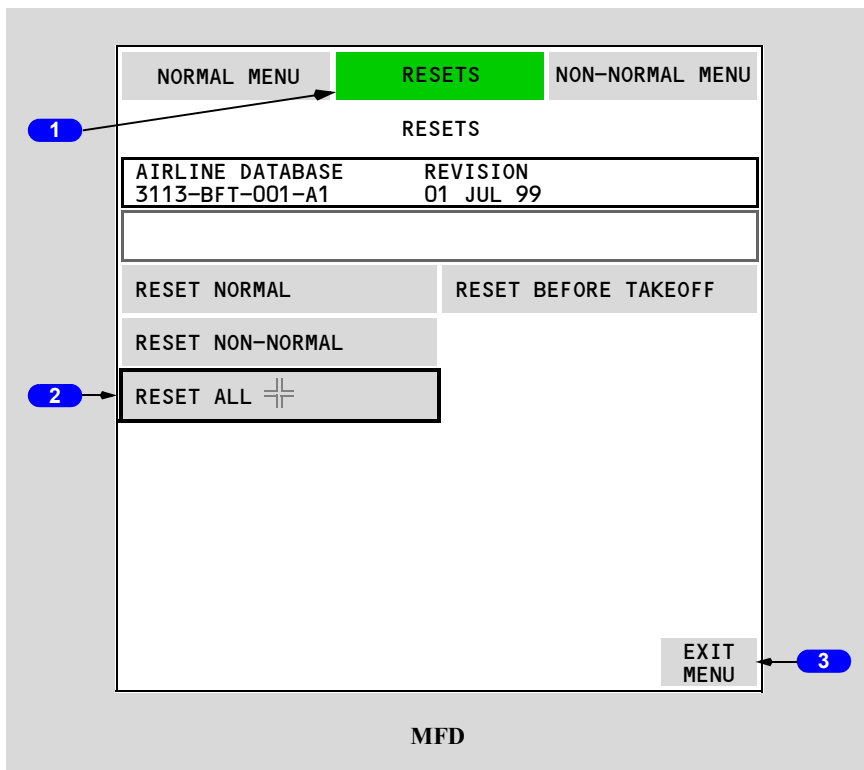
Select – displays non-normal checklists menu page. Page contains menu keys corresponding to airplane systems.

5 EXIT MENU Key

Select – exits page for access to the normal and non-normal checklist keys.

Resets Menu Page

[Option - Single ECL Database]



1 Resets Menu (RESETS) Key

Select – displays checklist resets page.

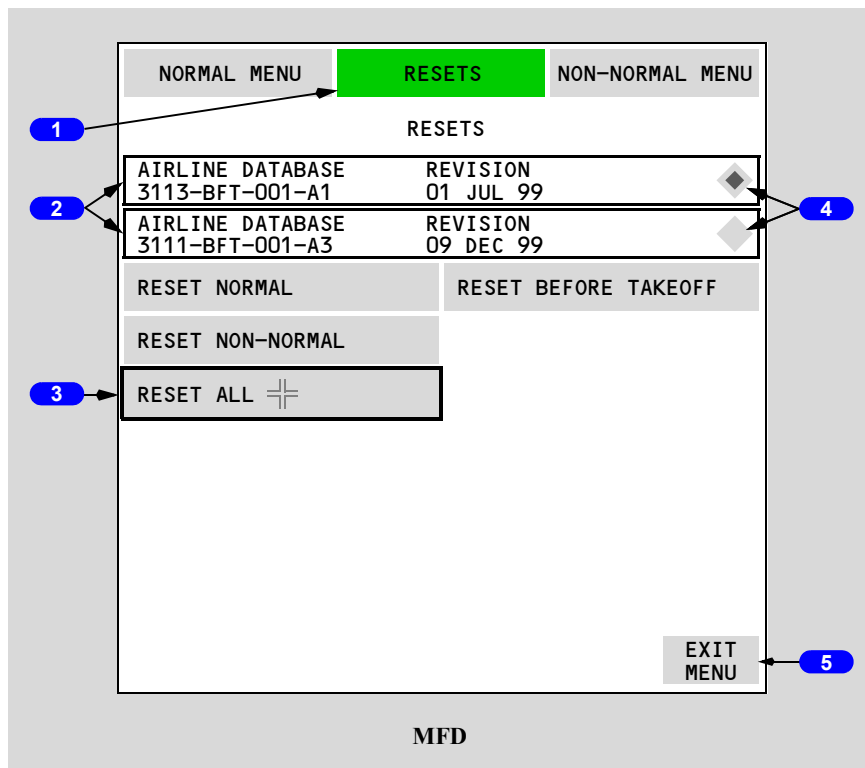
2 Reset Key

Select – resets checklists corresponding to title on key. All affected checklists become incomplete.

3 EXIT MENU Key

Select – exits page for access to the normal and non-normal checklist keys.

[Option - Dual ECL Database]



1 Resets Menu (RESETS) Key

Select – displays checklist resets page.

2 Database Selection Keys

Select -

- activates associated checklist database
- selection is only available when on the ground.

Displayed (white) - database is available for selection.

Displayed (cyan) - key is inactive. Database is inhibited from selection or database is invalid.

3 Reset Key

Select – resets checklists corresponding to title on key. All affected checklists become incomplete.

4 Active Database Indicators

Displayed (green diamond, gray background) - associated database is active.

Displayed (gray background) - associated database is inactive.

5 EXIT MENU Key

Select – exits page for access to the normal and non-normal checklist keys.

Intentionally
Blank

Flight Instruments, Displays
Electronic Checklist Description**Chapter 10**
Section 60

Introduction

Normal and non-normal electronic checklists can be displayed on any selected multifunction display (MFD). The electronic checklist system is not required for dispatch, and a paper checklist must be available on the flight deck.

Electronic checklists can be displayed on any MFD by pushing the checklist display switch on the display select panel. The checklists are controlled using either one of the two cursor control devices (CCDs). Cursor control devices and MFD selection are described in the System Description section of this chapter.

Electronic Checklist Operation

Pushing the checklist display switch on the display select panel displays the proper checklist (see Checklist Access, this section, for the checklist display priority order). Only one checklist is displayed at a time.

Three types of checklists can be displayed:

- normal
- non-normal associated with EICAS messages (annunciated)
- non-normal not associated with EICAS messages (unannunciated).

As each normal checklist is completed, pushing the checklist display switch displays the next sequential normal checklist.

Some checklist steps must be checked-off by the pilot to be completed. Other checklist steps are automatically checked-off from sensed flight deck control positions, airplane system status, and/or EICAS messages.

Checklist Status

The CHECKLIST COMPLETE indicator is displayed at the bottom of all pages of the checklist when all of the line items are either complete, inactive, or overridden, and every page has been displayed. If the flight crew chooses not to perform a particular line item, the line item can be overridden by selecting the ITEM OVRD key at the bottom of the page. When a line item is overridden, the text changes color from white to cyan and the current line item box moves down to the next incomplete line item. If the flight crew chooses to not perform an entire checklist, the checklist can be overridden by selecting the CHKL OVRD key at the bottom of the page. When a checklist is overridden, the text of the entire checklist changes color from white to cyan, and the CHECKLIST OVERRIDDEN indicator is displayed at the bottom of all pages.

Checklist Pages

The checklist is displayed on one or more pages. Page keys are located on the right side of each checklist containing more than one page. Page keys are not shown on checklists containing only one page.

When a checklist is complete and there are no additional checklists in the non-normal checklist queue, the cursor automatically moves to the normal checklist key in the lower left corner of the display. Pressing the cursor select switch displays the next sequential normal checklist. If there is one or more checklists in the non-normal queue, the cursor automatically moves to the non-normal checklist key in the lower right corner of the display. Pressing the cursor select switch displays the next appropriate non-normal checklist (if only one is in the queue) or the non-normal checklist queue.

When a checklist has more than one page, and the checklist steps on the current page are complete, the cursor automatically moves to the checklist page key corresponding to the next page. CONTINUED is displayed on the bottom of the page. Pressing the cursor select switch advances to the next checklist page. When the last page is complete, the cursor moves to the normal or non-normal checklist key as described above.

Checklist Line Items

Each step in a checklist is referred to as a line item. After selecting a checklist, the current line item box automatically encloses the text of the first incomplete line item. When the cursor is on that line item, the cursor selection box encloses the current line item box. When the line item becomes complete, the cursor, cursor selection box, and current line item box move to the next incomplete line item.

Incomplete checklist line items appear as white text. Complete line items appear as green text with a complete indicator (green check mark) to the left. Overridden and inactive line items are displayed in cyan.

Closed Loop Line Items

Closed loop line items are steps in the checklist that involve the continuous and automatic monitoring of switch, lever, or selector position. In a limited number of cases, actual system state, such as flap or landing gear position, is monitored. When the control is in the required position, the line item text color changes from white to green. In addition, a complete indicator is displayed left of the line item. The current line item box then moves to the next line item to be completed.

Open Loop Line Items

Open loop line items are steps in the checklist that require the flight crew to manually confirm completion by using the CCD cursor select switch. Open loop line items do not provide any monitoring of control position or system state. Open loop line items rely on the flight crew to confirm that the required action has been completed, or that a specific condition exists. Open loop line items can be distinguished from closed loop line items by display of the open loop indicator, a gray box located to the left of the line item. When the cursor is positioned within the current line item box or open loop indicator, and the CCD cursor select switch is pressed, the checklist line item text color changes from white to green and a complete indicator is displayed on the open loop indicator. The current line item box then moves to the next line item to be completed.

Operational Notes

Checklist operational notes are used for ongoing consequences of the non-normal condition, such as:

- inoperative equipment lists
- operational limitations.

Operational notes are selectable through the operational notes key at the bottom of the page. After display of a non-normal checklist that includes operational notes, the notes are accessible during all subsequent phases of flight. Each operational note includes a checklist reference for the checklist that generated the note.

If there are multiple pages of operational notes, page keys are displayed. Once all pages of operational notes have been accessed, the cursor is placed on the non-normal checklist key, if it is displayed, or moves to the normal checklist key.

Operational notes are dependent upon the status of the non-normal condition causing the note. If the condition goes away, the checklist reference and associated notes are removed from the operational notes display.

Deferred Line Items

Deferred line items are items that are part of a non-normal checklist, but must be accomplished later in the flight, usually during approach.

If a non-normal checklist containing deferred items is displayed, the items are automatically attached to the appropriate normal checklist. Each set of deferred items is referenced to the checklist that generated the deferred item. Any type of line item can be a deferred item.

A non-normal checklist containing deferred items is considered complete when all applicable steps prior to the deferred items have been accomplished. The CHECKLIST COMPLETE EXCEPT DEFERRED ITEMS indicator is displayed at the bottom of the page.

If a non-normal condition occurs after completion of the approach or landing checklist, the originating non-normal checklist is considered incomplete until all steps including the deferred items are accomplished.

Conditional Line Items

There are two types of conditional line items within checklists:

- closed loop (airplane system state sensed)
- open loop (airplane system state not sensed).

Open loop conditional line items are followed by selections labeled YES and NO. The cursor is placed adjacent to the YES – NO line, requiring the pilot to use the cursor to select the appropriate answer.

If the pilot selects YES, the steps associated with the conditional line item become active. If the pilot selects NO, the steps associated with the conditional line item become inactive and change color to cyan indicating the steps are not applicable. The current line item box skips past the cyan items. Cyan steps are not selectable. Any associated operational notes are removed from the notes page and deferred line items are removed from the target normal checklist when they are displayed in cyan. YES-NO selections remain active even after a selection is made. The pilot can change selections at any time.

Sometimes a group of two or more open-loop conditional line items are designated as a mutually exclusive set. When the pilot answers YES to any one of the items in the exclusive set, all other items are automatically answered NO. However, the opposite is not true. If all of the items but one are answered NO, the last item is not automatically answered YES. The pilot must manually select YES to one of the conditional line items in the exclusive set.

The closed loop conditional line item function is identical to open loop except the decision is made automatically by using airplane system state sensing. When the conditional line item is sensed true, it changes color to green and the current line item box moves to the first incomplete step associated with it. If the condition is sensed false, the conditional line item and its associated steps are no longer applicable and change color to cyan. The current line item box skips past the cyan items.

Inhibit Checklist Line Items

When a single airplane system failure results in the display of multiple EICAS alert messages (a primary message and one or more consequential messages), inhibit checklist line items allow unnecessary non-normal checklists (consequential checklists) to be inhibited from display in the checklist queue.

Consequential EICAS alert messages may be displayed as a result of a primary failure condition. For example, an AUTO SPEEDBRAKE message is displayed as a result of a HYD PRESS SYS C condition. Consequential EICAS alert messages also may result from a non-normal checklist crew action. For example, a PACK L message is displayed when the crew selects the pack off during accomplishment of the SMOKE AIR CONDITIONING checklist. Corresponding consequential checklists are inhibited by inhibit checklist line items in the primary checklist. The inhibit checklist line item lists the consequential checklists which are inhibited. The inhibit has the following effects on a consequential checklist:

- checklist icon is removed from corresponding EICAS message
- checklist is removed from checklist queue
- notes are not collected on operational notes page
- deferred items are not collected in normal checklists.

If consequential checklist steps, notes, and information are applicable to the primary failure condition, then these are included in the primary checklist.

Timers

Where required, an automatic timer is displayed in the upper right hand corner of the checklist page. Timers help the flight crew keep track of time delays that are part of checklists. All timers are countdown timers. Timers can be associated with open loop, closed loop, or conditional line items.

Timers are activated by completing the step just prior to the line item associated with the timer. Timers run in the background. This allows the flight crew to leave the checklist to accomplish other tasks and then return to the checklist. An accurate countdown time is displayed. Timers initially appear in white. When the time elapses, the timer displays 00:00 and the color changes to amber. When the current line item box moves to the next incomplete item, the expired timer is removed from display.

Checklist Menu Operation

An alternate means of operating the checklist is through the use of menus. The normal, resets, and non-normal menus can be selected by the keys at the top of the checklist page, using the cursor control device.

An EXIT MENU key is located in the lower right corner of all menu displays. This exits the menu page to allow access to the normal and non-normal checklist keys.

Normal Menu

Normal checklists are arranged in the menu in sequence. Selecting the NORMAL menu key or the checklist display switch results in the display of the next incomplete normal checklist in sequence.

Non-Normal Menu

Non-normal menu selections are arranged by airplane system. Submenus are used to select the appropriate checklist.

Resets Menu

Selecting the RESETS menu key displays miscellaneous information (such as checklist database part number and revision information) and the following selectable resets:

- RESET NORMAL
- RESET NON-NORMAL
- RESET ALL.

This provides a way to reset multiple checklists. See Checklist Resets, this section.

Dual Database

[Option - Dual ECL Database]

The dual database feature provides the flight crew the capability of activating either of two different ECL databases, each having a different database part number and revision identification. Revision identification usually corresponds to the Operations Manual revision or an effective date for the new database.

Selection of a different ECL database is accomplished on the RESET menu using the CCD. Database selection keys are used to activate the desired database. A green diamond displayed in the active database indicator shows the active database. The flight crew can select either ECL database as often as desired while on the ground. The database selection keys are inhibited in flight. Changing the active ECL database also results in RESET ALL action.

Checklist Access

Air/ground logic, fuel control switch position, and EICAS message level determine the checklist retrieval priority when the checklist display switch is pushed.

Checklist call-up priority order is shown below.

On the ground with both fuel control switches in the CUTOFF position and both engine start selectors in NORM:

- checklists associated with any EICAS warning messages
- NORMAL checklists (incomplete or not yet displayed)
- checklists associated with any EICAS caution messages
- checklists associated with any EICAS advisory messages
- unannunciated (no EICAS message) checklists.

On the ground with either fuel control switch in the RUN position, or either engine start selector not in NORM, or in the air:

- checklists associated with any EICAS warning messages
- checklists associated with any EICAS caution messages
- checklists associated with any EICAS advisory messages
- unannunciated checklists
- NORMAL checklists.

Normal Checklists

Normal electronic checklist use follows the same philosophy as used with paper checklists. The normal procedures are done from memory, then the checklist is read to confirm the actions.

Normal Checklist Access

The checklist sequence is:

- PREFLIGHT
- BEFORE START
- BEFORE TAXI
- BEFORE TAKEOFF
- AFTER TAKEOFF
- DESCENT
- APPROACH
- LANDING
- SHUTDOWN
- SECURE.

As each normal checklist is completed, the next incomplete normal checklist is displayed.

Any normal checklist can be accessed using the NORMAL menu.

Normal Checklist Completion

At the completion of each checklist (all steps are complete or overridden), the appropriate message appears at the bottom of the page:

- CHECKLIST COMPLETE (white text on green background)
- CHECKLIST OVERRIDDEN (white text on cyan background).

Non-Normal Checklists

Non-normal electronic checklist use is designed to follow the same philosophy as used with paper checklists. Non-normal checklists are done by read-and-do. If a checklist has memory steps, those steps are accomplished before accessing the checklist.

Non-Normal Checklist Access and Checklist Icon

Annunciated non-normal checklists are accessed by pushing the checklist display switch. Any non-normal checklist can be accessed using the NON-NORMAL menu.

EICAS messages determine which non-normal checklist is automatically displayed. EICAS alert messages with associated incomplete or unaccessed checklist procedures are displayed with an icon (a white, empty box) to the left of the message. The icon indicates checklist status. The presence or absence of the icon indicates:

- Icon displayed – the checklist for the displayed message has not been accessed, or the checklist has incomplete steps.
- Icon not displayed – all checklist steps are complete, there is no checklist procedure for the displayed message, or another message is displayed whose corresponding checklist inhibits display of the icon.

When pushing the checklist display switch and a single EICAS message exists, the non-normal checklist for that condition is displayed. If multiple active EICAS messages exist, pushing the checklist display switch displays a list showing the non-normal checklists ready for display. This list represents the non-normal checklist queue. If the number of checklists in the queue exceeds 10, a page indicator is displayed to the right of the list.

The checklist queue order is similar to EICAS message priority:

- EICAS WARNING
- EICAS CAUTION
- EICAS ADVISORY
- UNANNUNCIATED.

When a message becomes active, the corresponding checklist is automatically placed in the queue. After checklist completion, the message may still be active, but the checklist is removed from the queue. A checklist is also removed from the queue when another message is displayed whose corresponding checklist inhibits placement of the checklist in the queue.

Selection of the desired checklist in the queue is accomplished using the cursor, which is initially placed on the first checklist. Once a checklist is selected and completed, pressing the NON-NORMAL key returns the display to the queue, if additional non-normal checklists exist.

Non-Normal Checklist Completion

At the completion of each checklist (all steps are either complete, inactive, or overridden), the appropriate indicator is displayed at the bottom of the page:

- CHECKLIST COMPLETE (white text on green background)
- CHECKLIST OVERRIDDEN (white text on cyan background)
- CHECKLIST COMPLETE EXCEPT DEFERRED ITEMS (white text on green background).

If the checklist was left unfinished, the text in the non-normal checklist key in the lower right corner of the display changes color to amber to indicate that one or more non-normal checklists is incomplete.

Non-Normal Unannounced Checklists

Non-normal checklists not associated with EICAS messages are called unannounced checklists. Unannounced checklists are accessed only through menu selection. UNANNUNCIATED CHECKLISTS is the first submenu item when the NON-NORMAL menu is accessed. This menu selection provides quick menu access to all unannounced checklists.

Checklist Resets

If a checklist is partially complete or complete and the pilot wishes to begin the checklist again, the checklist must be reset. Selecting the checklist reset key at the bottom of the page while the checklist is displayed resets the checklist and allows the checklist to be accomplished again.

For certain conditions, such as go-around, resets are used to set the normal checklist back to a previous phase of flight. There are automatic resets and manual resets.

Normal Checklist Automatic Reset Conditions

Automatic checklist resets occur for the following conditions:

- GO-AROUND – if the airplane is in the air, the landing gear is not up, and TO/GA is selected, then all normal checklists beginning with the AFTER TAKEOFF checklist automatically reset.
- TOUCH-AND-GO – if the airplane has transitioned from air to ground, takeoff thrust is reached with groundspeed greater than 80 KIAS, and the thrust reversers not deployed, then all normal checklists beginning with the AFTER TAKEOFF checklist automatically reset.
- NORMAL MENU CHOICE – if a previously completed checklist is selected from the menu, it automatically resets when it is displayed.

Normal Checklist Manual Resets

Manual checklist resets are required for the following conditions:

- **RESET NORMAL** – selecting the resets menu key and then the reset key labeled **RESET NORMAL** resets all normal checklists. The flight sequence begins again.
- **INDIVIDUAL CHECKLIST RESET** – selecting the checklist reset key resets any displayed checklist. The checklist is then ready to accomplish again.

Non-Normal Checklist Manual Resets

- **RESET NON-NORMAL** – selecting the resets menu and then the reset key labeled **RESET NON-NORMAL** resets all non-normal checklists. The flight crew is prompted to reaccomplish all annunciated non-normal checklists that were previously completed. Use of the **RESET NON-NORMAL** function in flight is not recommended.
- **INDIVIDUAL CHECKLIST RESET** – selecting the checklist reset key resets any displayed checklist. The checklist is then ready to accomplish again.

Manual Reset All

- **RESET ALL** – selecting the resets menu and then the reset key labeled **RESET ALL** resets all normal and non-normal checklists. The flight crew is prompted to re-accomplish all annunciated non-normal checklists that were previously completed. Use of the **RESET ALL** function in flight is not recommended.

Overrides

There are two types of override functions: item override and checklist override.

Item Override

Item override is used by the flight crew when an item in a checklist will not be accomplished or an item has been accomplished but the closed-loop sensing is not functioning correctly. Overriding an item when required allows the checklist to be completed.

The line item override key is available on all checklists. Selection of the line item override key changes the color of the highlighted step to cyan, indicating the step is not applicable and is overridden. Both closed loop and open loop steps can be overridden.

Conditional line items (both closed and open loop) cannot be overridden. Individual steps associated with conditional line items can be overridden.

Checklist Override

Checklist override is used by the flight crew when a checklist in the non-normal queue will not be accomplished or after the crew browses a checklist but does not intend to complete it.

By pressing the checklist override key, the displayed checklist changes color to cyan, indicating that it is overridden. The CHECKLIST OVERRIDDEN indicator is displayed at the bottom of the page. For non-normal checklists, all associated operational notes are removed from the operational notes page, and deferred line items are removed from the target normal checklist.

Electronic Checklist System Inoperative

If the checklist display switch is pushed and the electronic checklist system is inoperative, the message CHECKLIST NOT AVAILABLE is displayed on the MFD. If the electronic checklist system has been disabled by maintenance, the message CHECKLIST DISABLED is displayed on the MFD.

When the electronic checklist system is inoperative or disabled, checklist icons are not displayed on the EICAS display for any messages.

Intentionally
Blank

Flight Instruments, Displays
Electronic Flight Bag (EFB)**Chapter 10**
Section 65[\[Option\]](#)

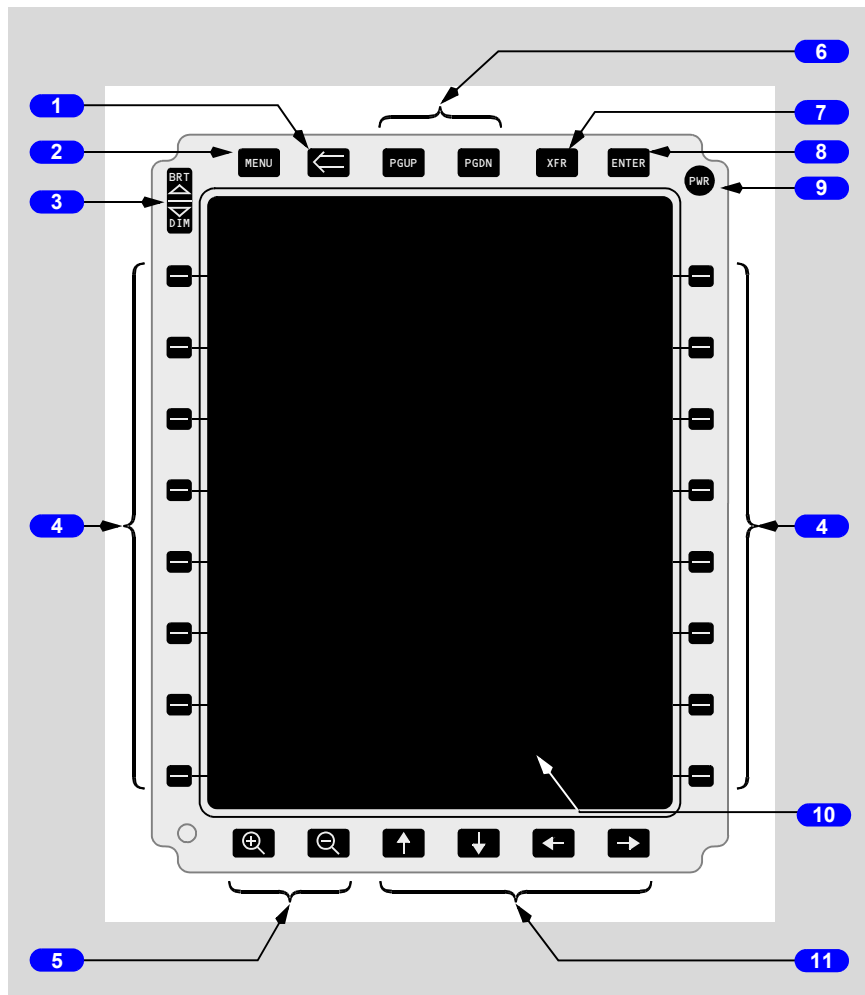
Introduction

The electronic flight bag (EFB) is a suite of applications designed to assist the flight crew with routine tasks and reduce the reliance on paper documents. The flight crew interacts with the EFB through display units located on the side panels. The display units operate independently of each other.

Under typical flight conditions, the majority of pilot interactions consists of manipulating Line Select Keys or the touch screen on a display unit to move back and forth among applications, within applications, and to display data. In addition, the flight crew can use the cursor control device (CCD) or an optional keyboard.

The suite of applications available to the flight crew may be customized by airlines. User modifiable portions of each application may be further customized. These customizing options include assigning applications to keys, revising application names, and defining the order in which applications appear. Descriptions and illustrations provided in this section are examples of a typical installation and may not reflect the exact installed configuration.

Display Unit



1 Back Key

Returns to the previous level within an application.

2 Main Menu (MENU) key

Displays MAIN MENU.

3 Bright (BRT) Dim (DIM) Control

Rocker switch, upper portion brighter, lower portion dimmer.

4 Line Select Keys

Selects item next to key.

5 Zoom Keys

Left key is zoom in, right is zoom out. Repeated selection increases or decreases the zoom level.

6 Page Up (PGUP)/Page Down (PGDN) Keys

Moves up or down within an application where the display exceeds one display screen in length.

7 Transfer (XFR) Key

- View other pilot's EFB display on this display
- XFR displays in green text on upper right
- Selections made off-side are seen on the on-side display in real time
- XFR key (second push) exits transfer and returns display to last view prior to selecting XFR
- MENU key exits transfer and displays the MAIN MENU

8 Enter (ENTER) Key

Activates a high-lighted item when applicable.

9 Power (PWR) Switch

Turns the display backlight on or off.

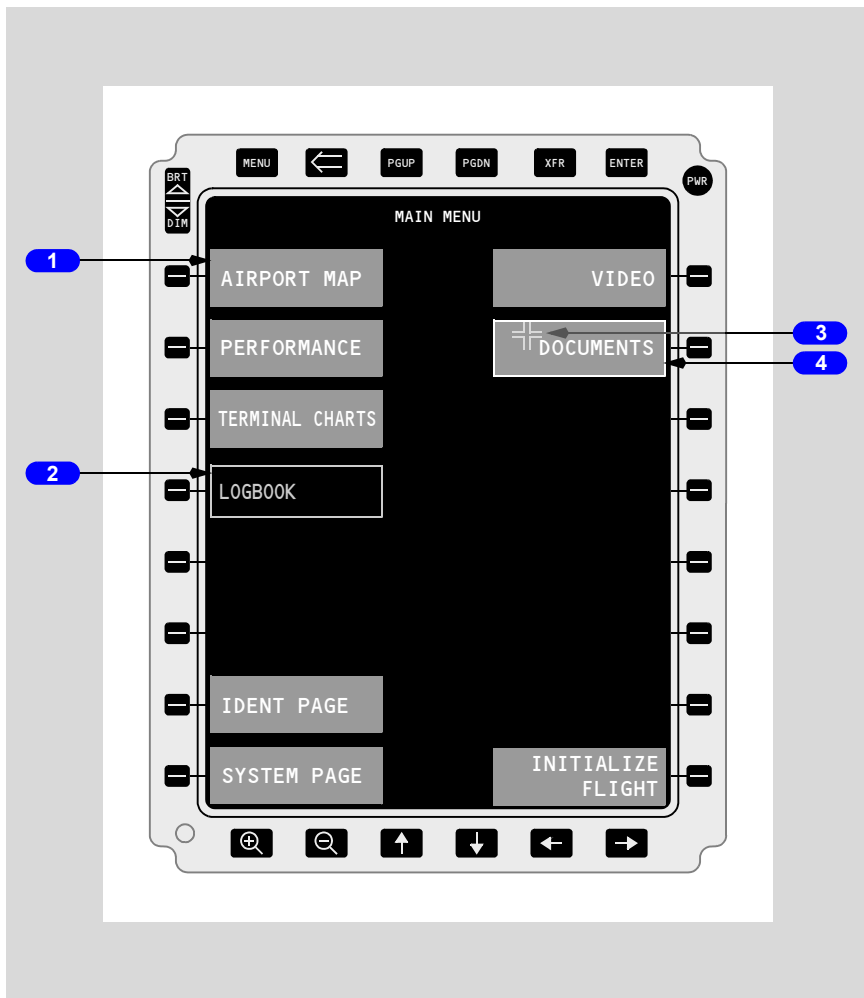
10 Touch sensitive screen

Enables direct selection on the display screen, and in some applications panning and scrolling.

11 Arrow Keys

Moves the viewing window over the display in the direction of the selected arrow.

Display Description



1 Selectable Applications

Menu items for selectable applications display in white text with gray background.

2 Applications not selectable

Menu items for applications that are installed but are not selectable display in cyan text in a cyan box. An application may be initializing and may become selectable later.

3 Cursor

A magenta cursor appears on the display when the SIDE switch is selected on a cursor control device.

4 High-light Box

A white high-light box displays around a selectable application when:

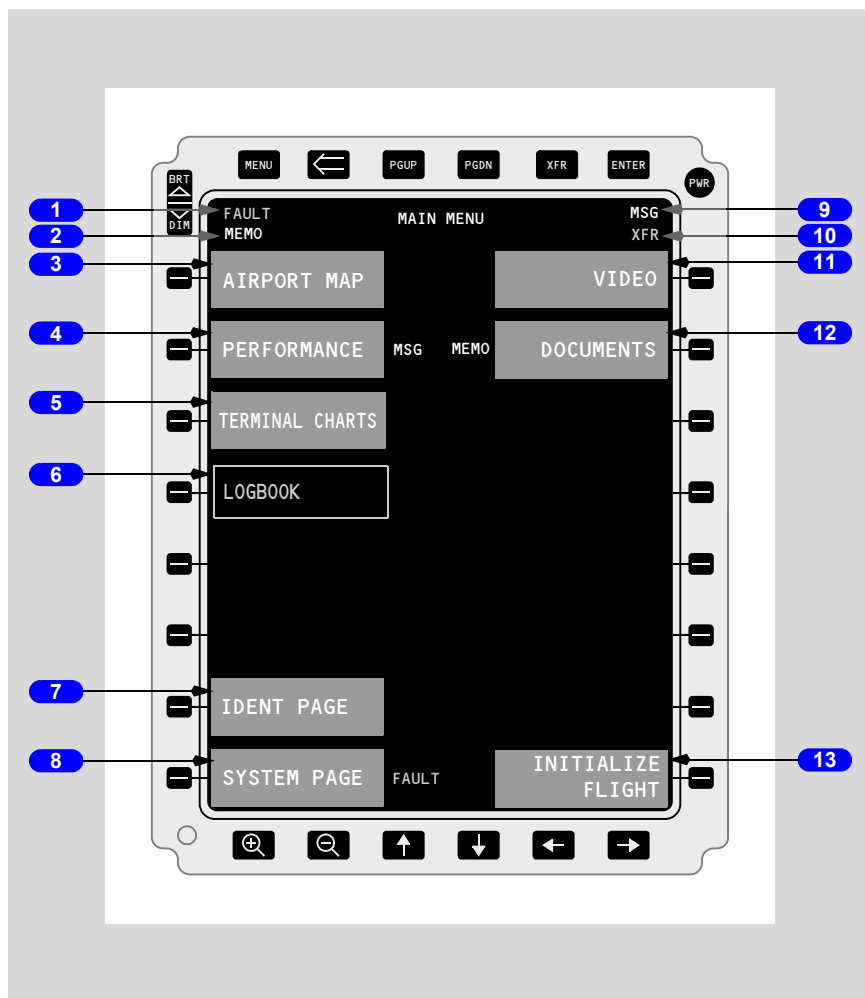
- The cursor is moved over the menu item
- The selectable menu item is touched
- A line select key is selected

A selectable application is selected when:

- It is high-lighted with the cursor and the cursor select switch is pushed
- A menu item is touched and released
- A line select key is selected

The menu item for a selected application displays a green background momentarily and then the selection displays.

Main Menu (Typical)



1 FAULT

Displayed (amber) -

- A fault has occurred within an application
- Displays in the header regardless of the application displayed
- Displays next to the SYSTEM PAGE where fault message can be viewed and cleared
- Removed from header upon selection of the SYSTEM page

Only one message at a time may display next to an application. FAULT takes priority over MEMO and MSG. MEMO or MSG display as applicable after the fault is cleared.

2 MEMO

Displayed (white) -

- One or more applications need attention
- Displays in the header regardless of the application displayed
- Displays next to the affected application on the MAIN MENU

3 AIRPORT MAP Application

Selects the AIRPORT MAP application.

- After flight initialization, displays the departure airport in HDG-UP (heading up) mode when on the ground at the departure airport
- Displays the destination airport NORTH-UP when in the air
- Displays the destination airport HDG-UP when on the ground at the destination airport

4 PERFORMANCE Application

Selects the PERFORMANCE application.

- After flight initialization, displays the takeoff performance page
- Subsequent selections of the application display the selection that was in view when the application was last exited

5 TERMINAL CHARTS

Selects the TERMINAL CHARTS application.

- After flight initialization, displays the ROUTE SETUP page.
- Origin and destination information downloaded from the FMS.

6 LOGBOOK

Selects the LOGBOOK application.

7 IDENT PAGE

Displays the IDENT page.

8 SYSTEM PAGE

Displays the SYSTEM page.

9 MSG

Displayed (white) -

- One or more applications has an uplink available
- Displays in the header regardless of the application displayed
- Displays next to the affected application on the main menu. Takes priority over MEMO

10 XFR

Displayed (green) -

- The display is in transfer mode
- No selections except MENU and XFR are enabled

11 VIDEO Application

Displays views from surveillance cameras of area outside the flight deck door.

12 DOCUMENTS Application

Selects the DOCUMENTS application

- After flight initialization, displays the documents library
- Subsequent selections of the application display the selection that was in view when the application was last exited

13 INITIALIZE FLIGHT

Initializes all the installed applications for flight

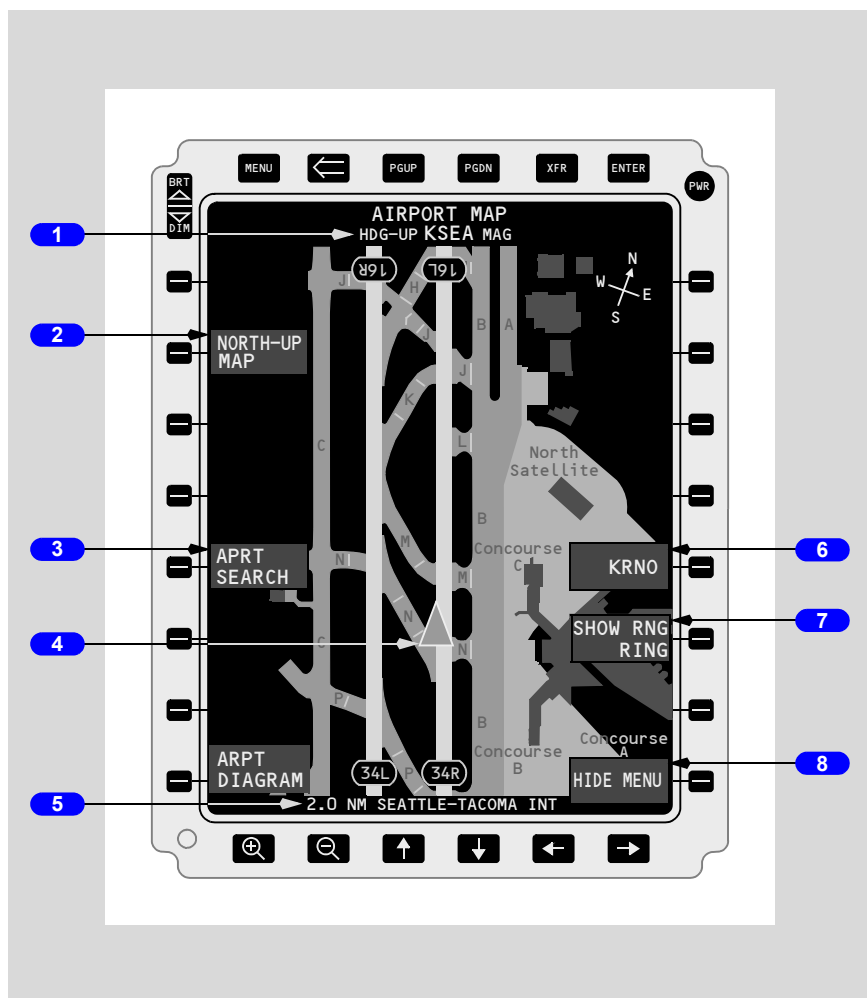
- Clears search results of all previous searches in all applications
- All applications and functions restored to default settings
- Cross loads from FMC applicable data if it has been entered in the FMC
- Menu changes to CLOSE FLIGHT
- CLOSE FLIGHT is not selectable (cyan) during flight

Airport Maps (Typical)

The maps are based on precise survey of airport geometry by satellite and other means. There may be differences between the electronic airport map and the airport diagrams that are part of the terminal charts, since these charts are derived from different survey methods.

Airport Heading Up (moving) Map

The airplane symbol remains stationary and the map moves to provide the location and orientation of the airplane relative to the map.



1 Map Reference

Displays the map reference.

- HDG-UP (heading up) and MAG (magnetic)

2 NORTH-UP MAP

Selects north up (static) map display.

3 Airport (APRT) SEARCH

Allows searching the database for other airport maps.

4 Airplane symbol

Displays when airplane is on the ground at the displayed airport and groundspeed is less than 40 knots.

5 Display range

Indicates the map range from top to bottom of the display.

6 Airport Identifier

When departure airport is displayed, identifier is destination airport if entered in FMC.

- Selection displays the destination airport in HDG-UP (moving map) mode when on the ground at the destination airport
- Displays the destination airport in NORTH UP (static) mode when in the air

When destination airport is displayed, identifier is departure airport.

7 SHOW/HIDE Range (RNG) RING

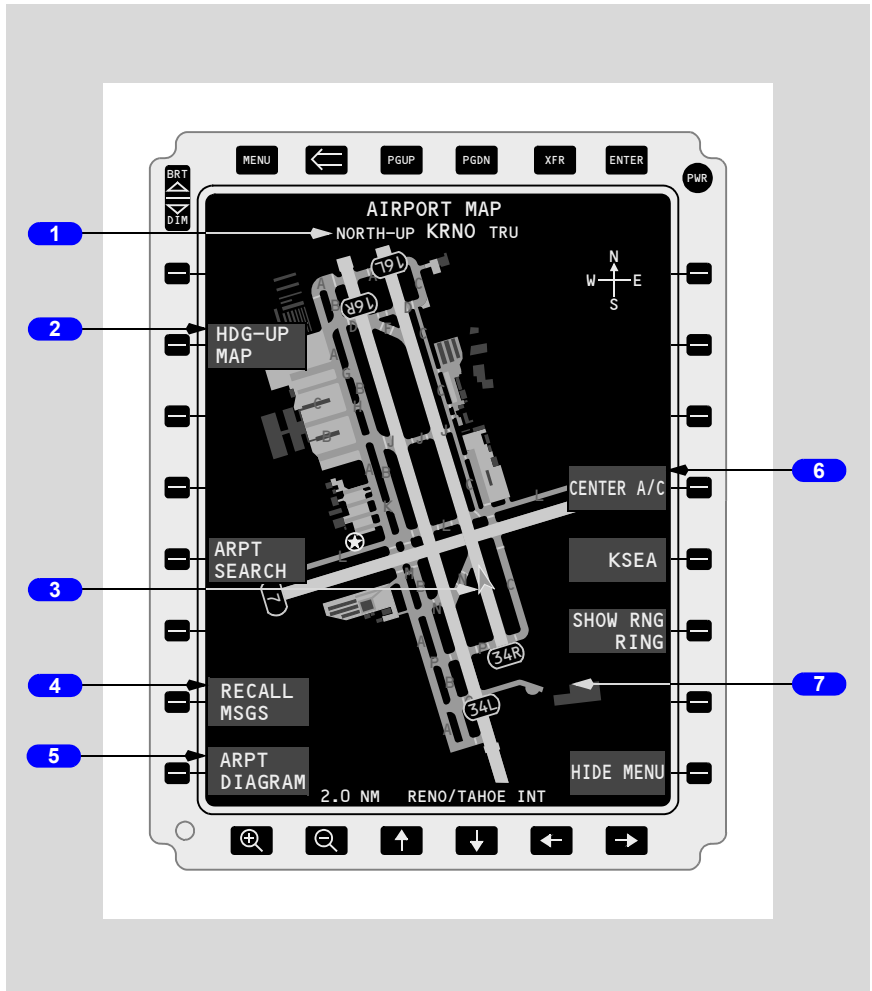
Displays or removes a 1000 foot radius range ring around the airplane symbol.

8 SHOW/HIDE MENU

Displays or hides all other menu selections.

Airport North Up (static) Map

The airplane symbol moves on a stationary map showing the airplanes general location and orientation on the ground at the selected airport. Using the touch screen to “touch and drag”, or using the arrow keys, the map may be repositioned on the display.



1 Map reference

Displays the map reference

- NORTH UP
- TRU (true) heading

2 HDG-UP MAP

On the ground, selects heading up moving map display.

In the air, the prompt is HDG -UP ARMED. This enables an automatic change to the HDG-UP display upon landing.

3 Airplane Symbol

Displays when airplane is on the ground at the displayed airport and groundspeed is less than 40 knots.

4 CANCEL/RECALL MSGS (Messages)

Toggles between Cancel and Recall when map faults exist

- CANCEL removes fault messages from the display
- RECALL re-displays fault messages

The menu item is inhibited when there are no faults to display.

5 ARPT (Airport) DIAGRAM

Displays the airport chart (10-9 chart) for the displayed airport map.

6 CENTER A/C

Centers airplane symbol horizontally and vertically on the display.

7 Map fault message display area

Amber fault messages display in this area. More than one message may display at a time.

Airport Map Faults

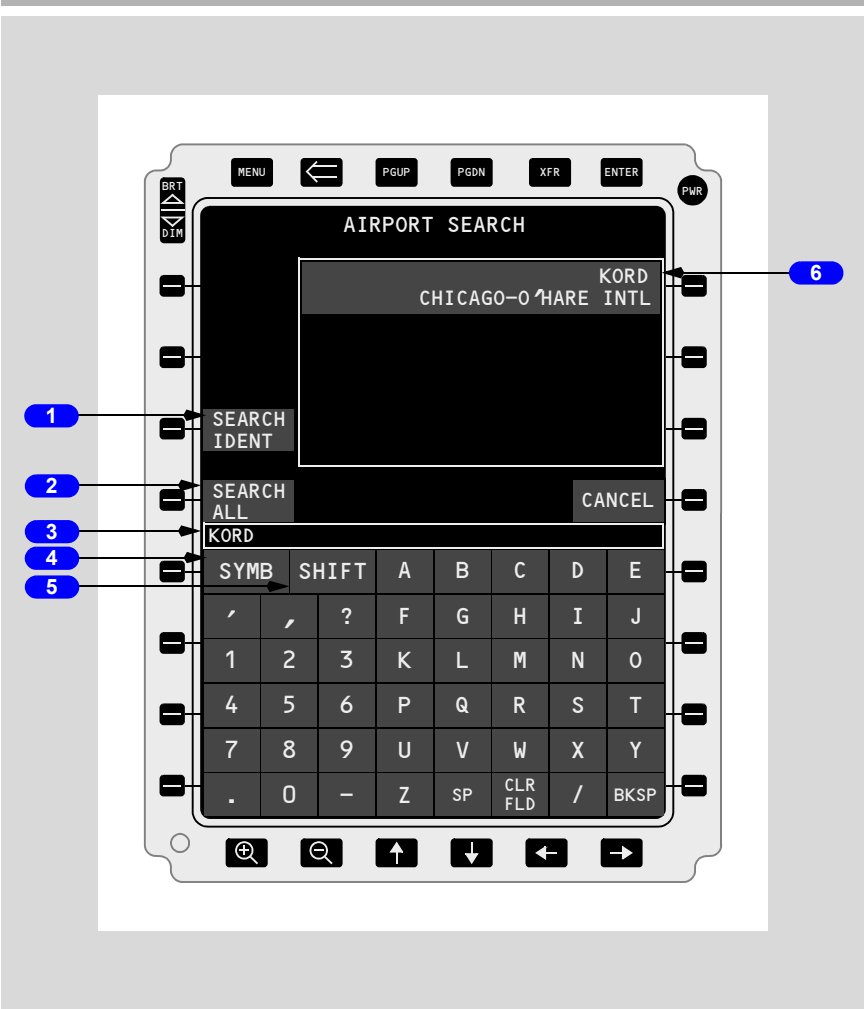
Display (amber) -

Faults may appear on both NORTH-UP and HDG-UP displays.

Fault	NORTH-UP	HDG-UP
ADIRU DATA (ADIRU data is lost or invalid.)	Airplane symbol is removed.	Airplane symbol is removed. Map freezes on position and last known heading.
GPS DATA (GPS position data is lost or invalid.)	Airplane symbol is removed.	Airplane symbol is removed. Map freezes on heading and last known position.
UNABLE POS ACCURACY (GPS position accuracy limits are exceeded. Inhibited by GPS DATA and when in flight.)	Airplane symbol is removed.	Airplane symbol is removed. Map freezes on heading and position

Airport Search

Airport search allows the search and display of other airport maps. Keypad operation for entering, clearing, and deleting characters is the same as with the FMS CDU. All EFB applications that have a search function use an identical keypad and scratchpad in the lower half of the respective search display.



1 SEARCH IDENT

Initiates a search of the ident data base using the scratchpad entry.

2 SEARCH ALL

Initiates a search of the data base using the scratchpad entry.

3 Scratchpad**4 SYMB/NUM key**

Alternates between SYMB and NUM.

- SYMB displays symbols on the keypad
- NUM displays numbers on the keypad

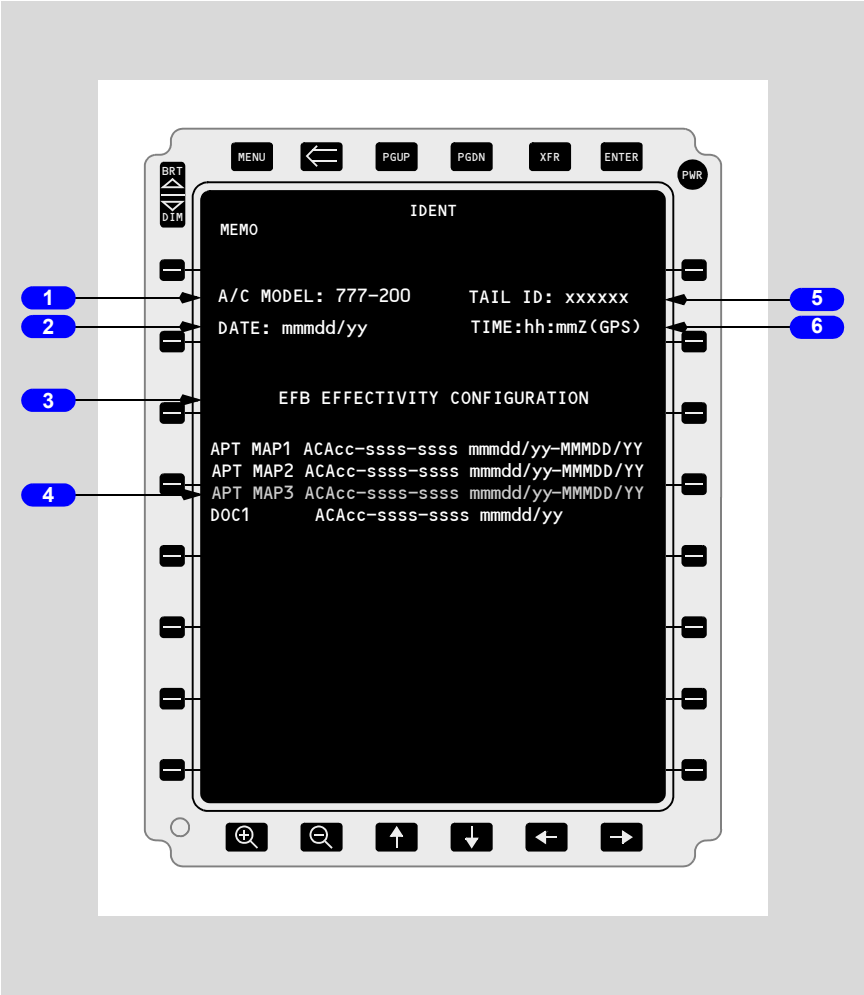
5 SHIFT key

Changes letter keys between upper case and lower case.

6 Airport Identifier

The results of the airport search are displayed here. Selecting the airport displays the airport map in North Up mode.

IDENT page (Typical)



1 A/C MODEL

Display of aircraft model.

2 DATE

Display of current date.

3 EFB EFFECTIVITY CONFIGURATION

Display of effectivity dates for loaded databases.

4 Out of date data base (amber)

An out of date database displays in amber. MEMO displays in the header on all pages and next to affected applications on the Main Menu page.

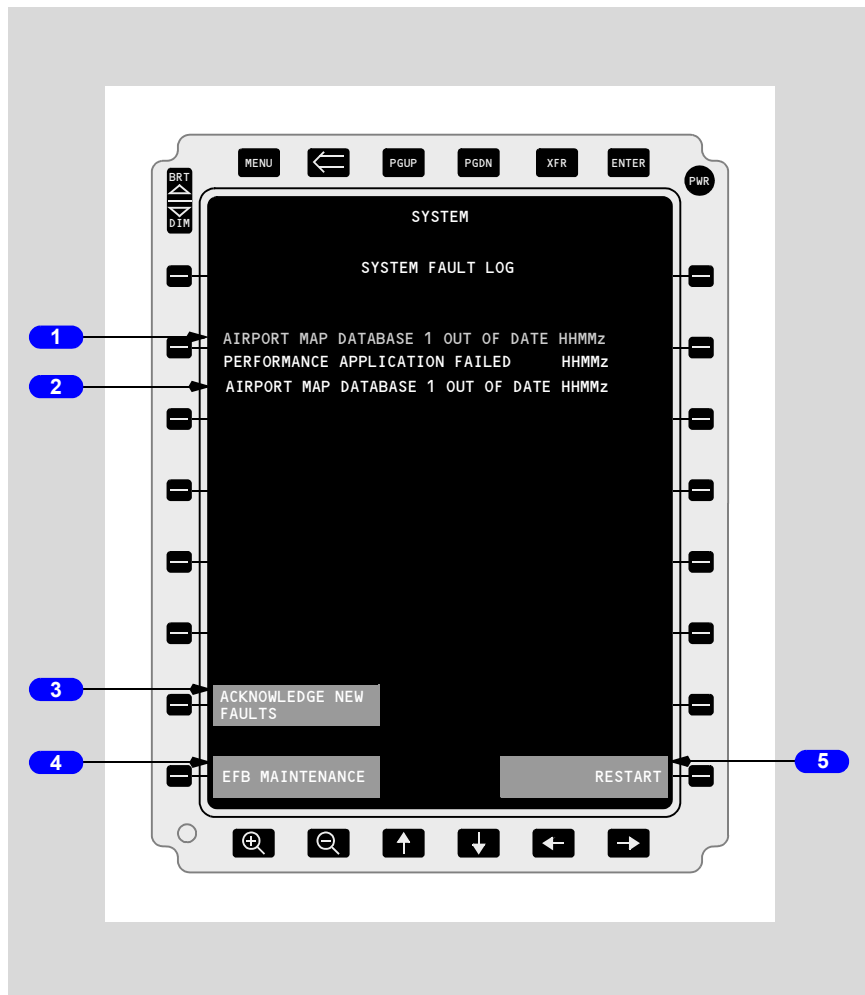
5 TAIL ID

Display of tail identification number.

6 TIME

Display of time and source of time.

SYSTEM page (Typical)



1 Acknowledged fault

Fault information is displayed in cyan.

2 Un-acknowledged fault

Fault information is displayed in white.

3 ACKNOWLEDGE NEW FAULTS

- Becomes selectable when there are un-acknowledged faults
- Selection acknowledges all new faults
- Selection removes FAULT on MAIN MENU next to SYSTEM

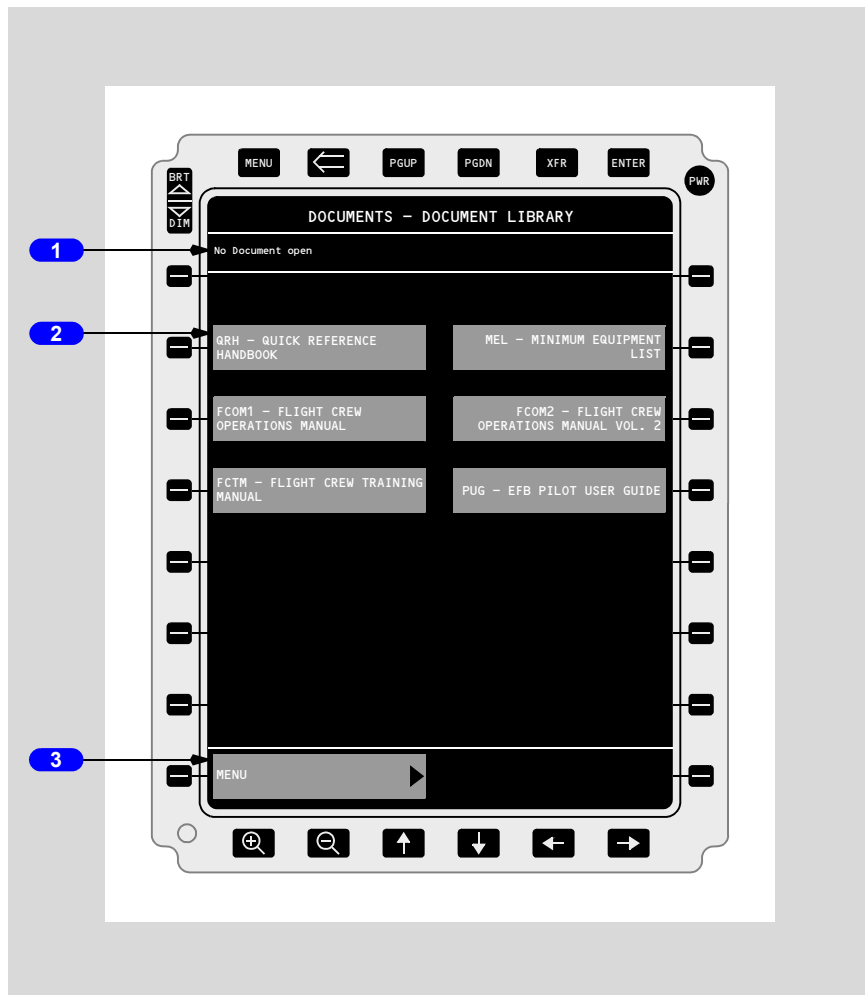
4 EFB MAINTENANCE

Provides access to the maintenance menu page.

5 RESTART

Re-initializes Windows applications.

Documents (Typical)



1 Document hierarchy header

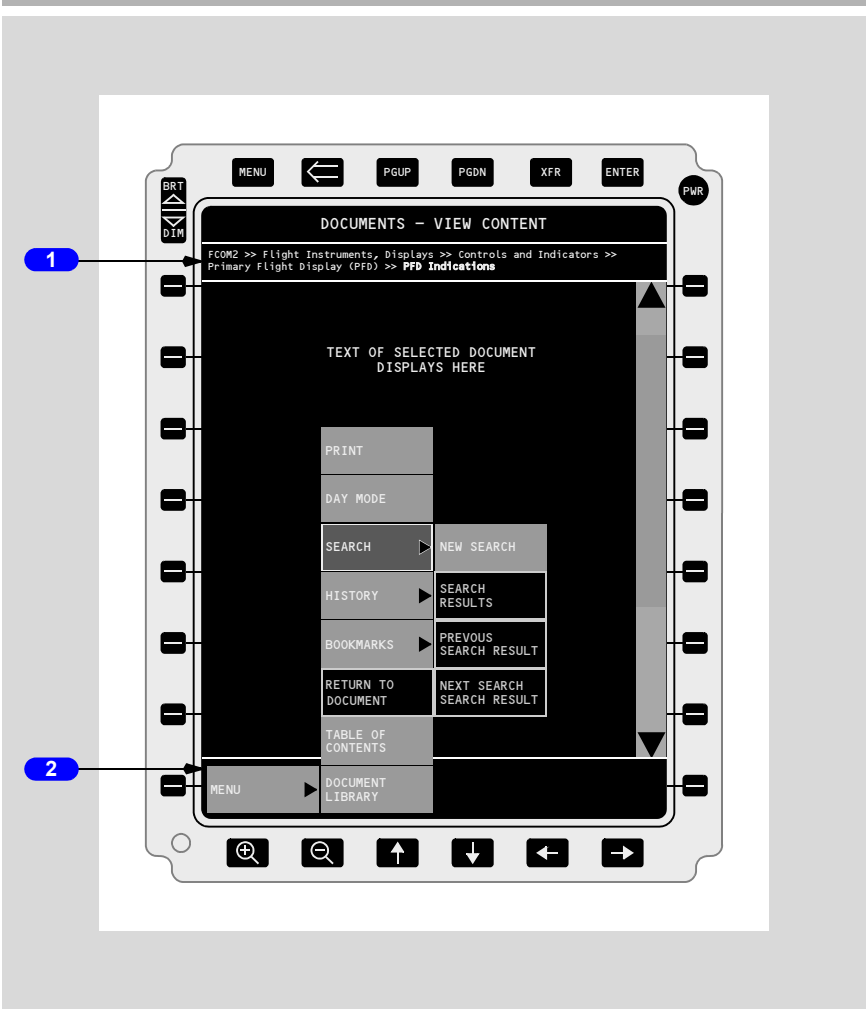
Displays the selected document, section, and sub-section.

2 Selectable documents

Displays the installed and selectable documents.

3 MENU

Initiates cascading menu.



1

Document hierarchy header

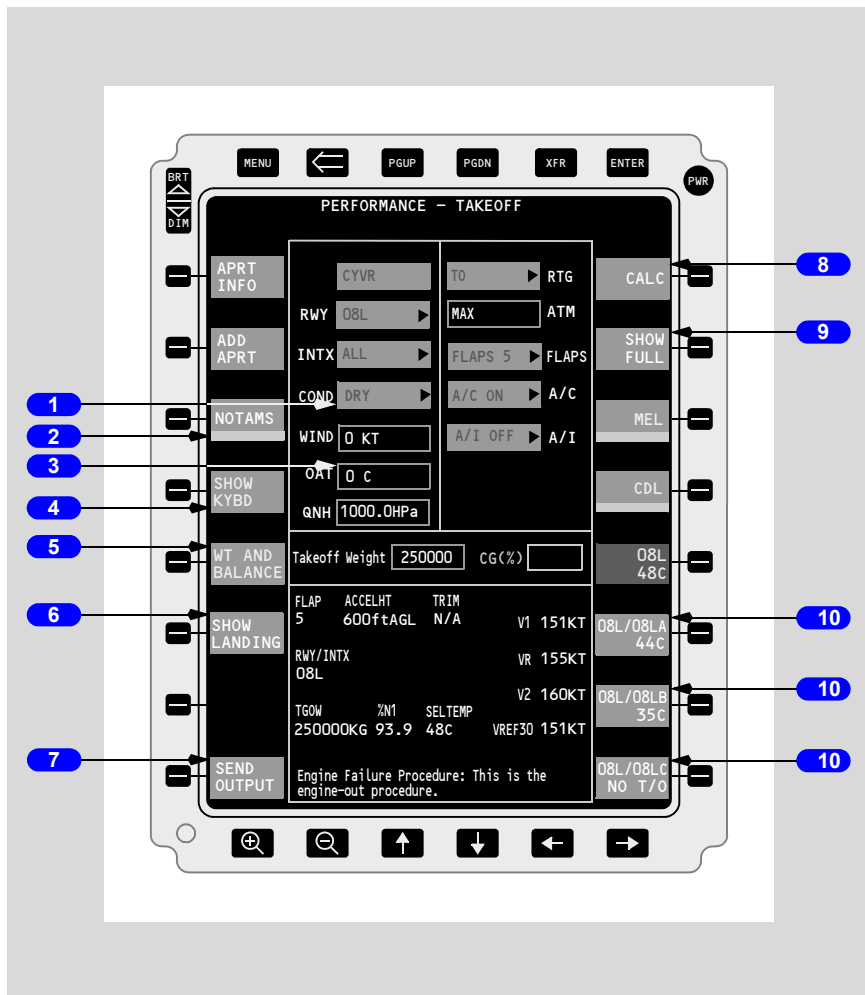
Displays the current document, section, and sub-section.

2 MENU

Initiates cascading menu. Selected item has green background, available item has gray background, and item not selectable is blue. For example, if another function is selected, the RETURN TO DOCUMENT function turns white with a gray background.

- PRINT - Information displayed in the VIEW CONTENTS screen is printed on the flight deck printer (if applicable).
- DAY MODE - Indicates inactive display mode, selection changes mode to mode indicated. Day mode is dark text on a light background, night mode is light text on a dark background.
- SEARCH - Initiates search in multiple documents.
- HISTORY - Displays a list of entries as links for information previously displayed in the VIEW CONTENTS screen.
- BOOKMARKS - Provides link to return to item bookmarked.
- RETURN TO DOCUMENT - Allows return to document from subordinate function.
- TABLE OF CONTENTS - For the document selected.
- DOCUMENT LIBRARY - Provides list of all available documents.

Performance (Typical)



1 DRY (green)

- DRY has been selected for the runway condition
- Triangle in right side of menu indicates a list of options exists
- Selection display the options

2 NOTAMS

- May be used to enter temporary data
- Amber bar displays across menu when data has been entered

3 Data field

Boxes display for fields that require data entry.

4 SHOW KYBD (Keyboard)

Displays a touch sensitive keyboard at the bottom of the page that is used for data entry.

5 WT (Weight) AND BALANCE

Displays the weight and balance page.

6 SHOW LANDING

Displays the landing page.

7 SEND OUTPUT

Opens listing with available options for saving or printing data.

8 CALC (Calculate)

- Cyan - data has not been entered in all required fields
- White - all required fields have data

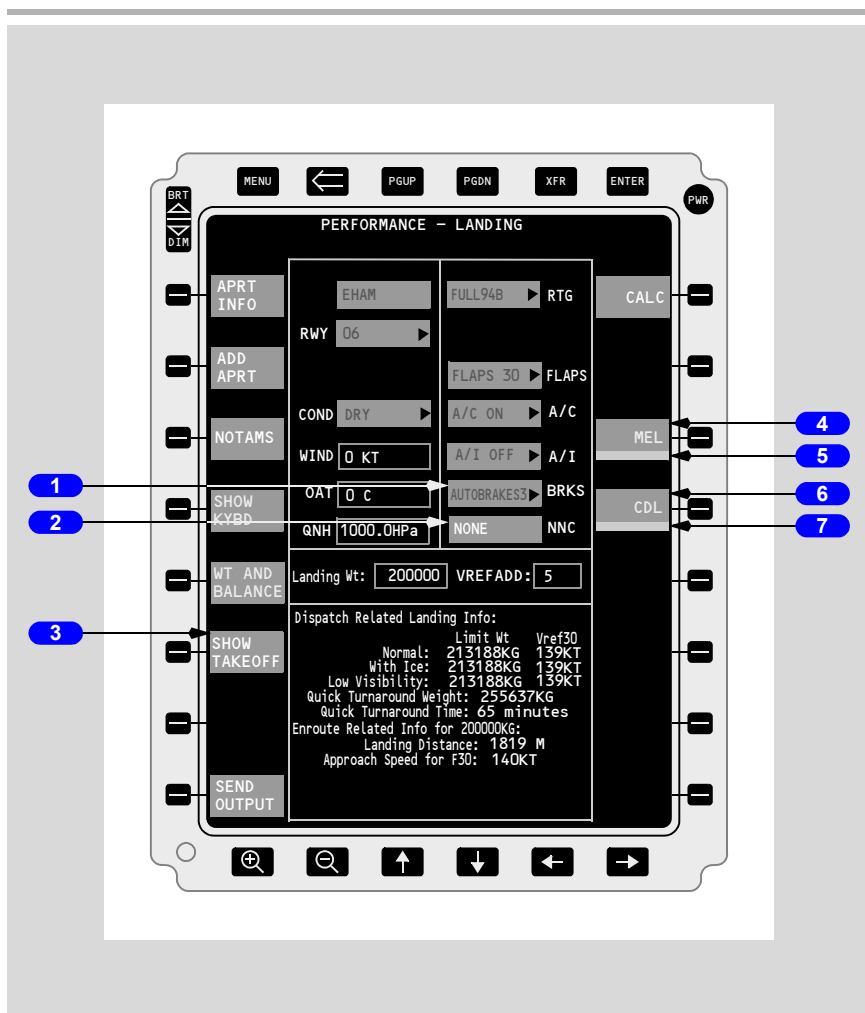
Selection initiates the calculation of takeoff data.

9 SHOW FULL

Selection displays full thrust data for the airport/runway entered.

10 Intersection Takeoff Options

- Intersection takeoff options display on the right side when ALL is selected for INTX (intersection)
- Selection displays takeoff data for the selected intersection

**1 BRKS (Brakes)**

Selection of a brake setting is required for in-flight landing calculations, not dispatch calculations.

2 NNC

Selection is required for in-flight calculations, not dispatch calculations.

3 SHOW TAKEOFF

Displays the takeoff page.

4 MEL

Displays MEL page.

5 Amber bar

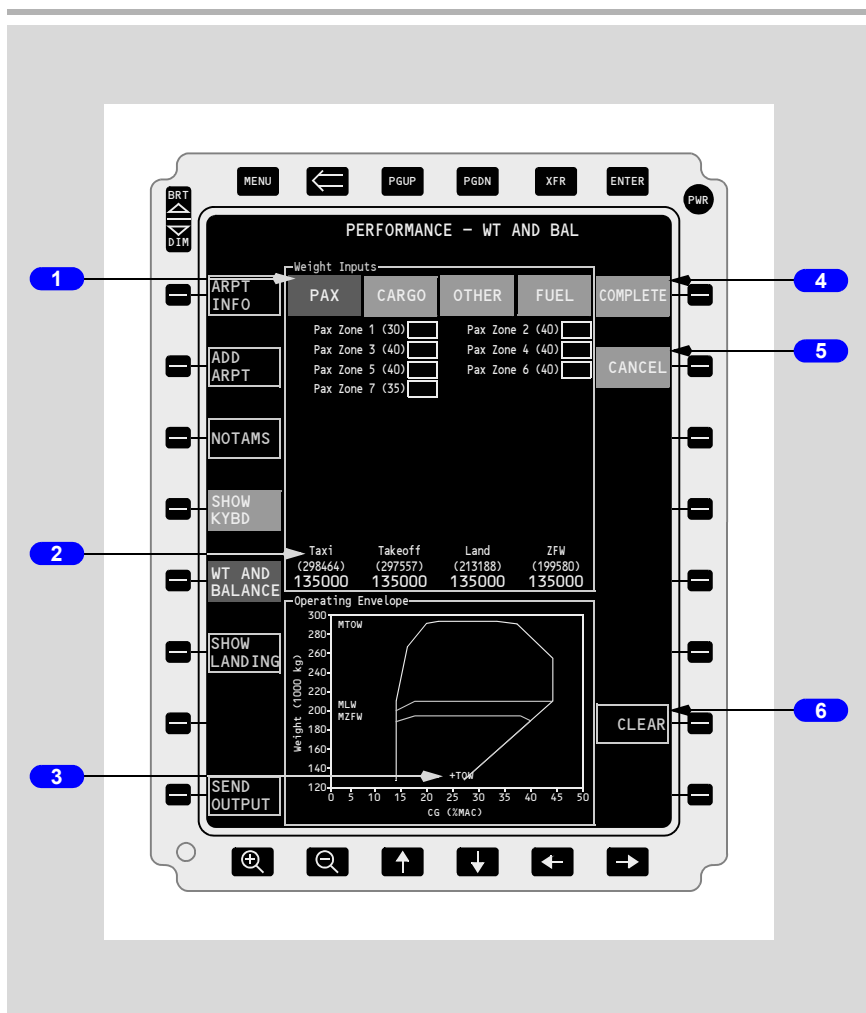
Indicates an active MEL item exists that will be considered in the calculations.

6 CDL

Displays the CDL page.

7 Amber bar

Indicates an active CDL item exists that will be considered in the calculations.

**1 PAX/CARGO/OTHER/FUEL**

Displays applicable input screen.

2 Aircraft weights

- Initially displays airplane operating empty weight
- Updates as data fields are filled

3 +TOW

Symbol displays airplane CG relative to the CG limits.

4 COMPLETE

Selection loads the takeoff page with the calculated takeoff gross weight and CG.

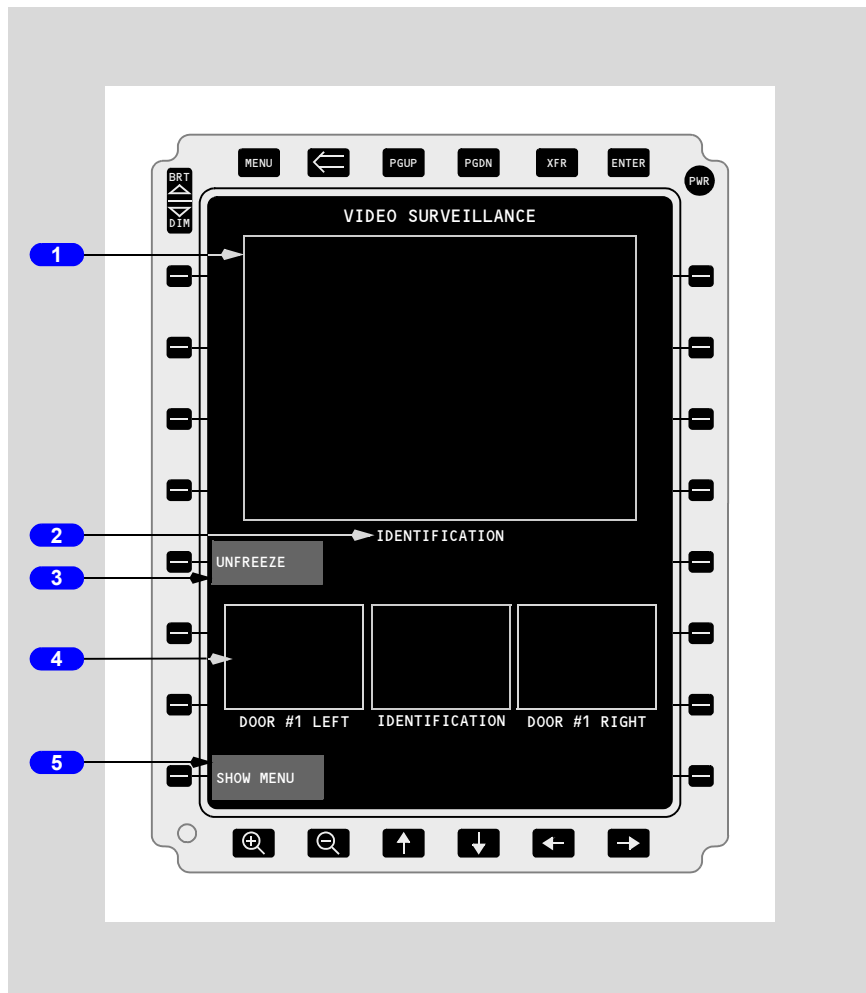
5 CANCEL

Clears all entries and returns to the takeoff page.

6 CLEAR

Clears all entries.

Video Surveillance (Typical)



1 Primary Display

- Selected thumbnail image displays in this area with green border
- Border changes to cyan when FREEZE is selected
- Border is amber when the selected image is not available and NO VIDEO SIGNAL displays

2 Display selection

Name of the selected thumbnail image displays here.

3 FREEZE/UNFREEZE

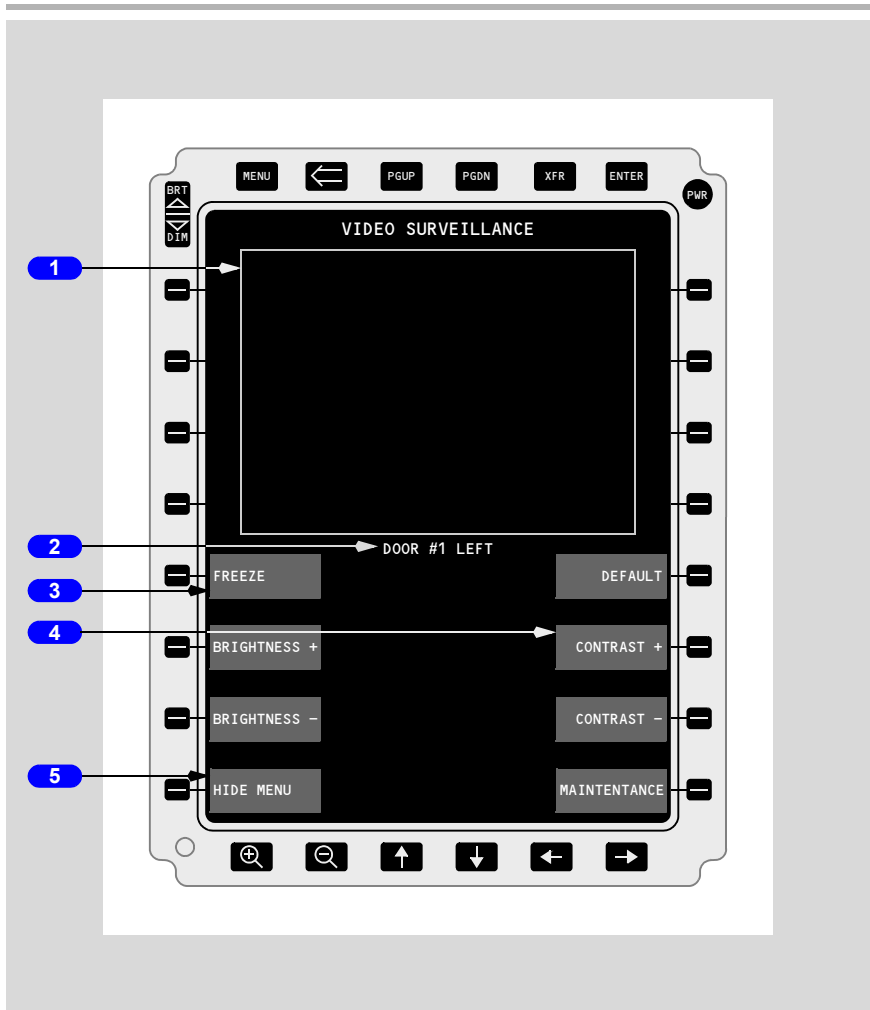
- Selection freezes the image in the primary display
- The display box changes to cyan while the image is frozen
- The menu changes to UNFREEZE

4 Thumbnails

- Thumbnail images display here
- Images with a gray border may be selected for display in the primary display
- Selected image has a green border
- Border is white when the cursor is moved over the image
- Border is amber when the image is not available and NO VIDEO SIGNAL displays

5 SHOW/HIDE MENU

- Selecting SHOW MENU adds the BRIGHT, CONTRAST, and MAINTENANCE menus
- After selecting SHOW MENU, the menu changes to HIDE MENU

**1 Primary Display**

- Selected thumbnail image displays in this area with green border
- Border changes to cyan when FREEZE is selected
- Border is amber when the selected image is not available and NO VIDEO SIGNAL displays

2 Display selection

Name of the selected thumbnail image displays here.

3 FREEZE/UNFREEZE

- Selection freezes the image in the primary display
- The display box changes to cyan while the image is frozen
- The menu changes to UNFREEZE

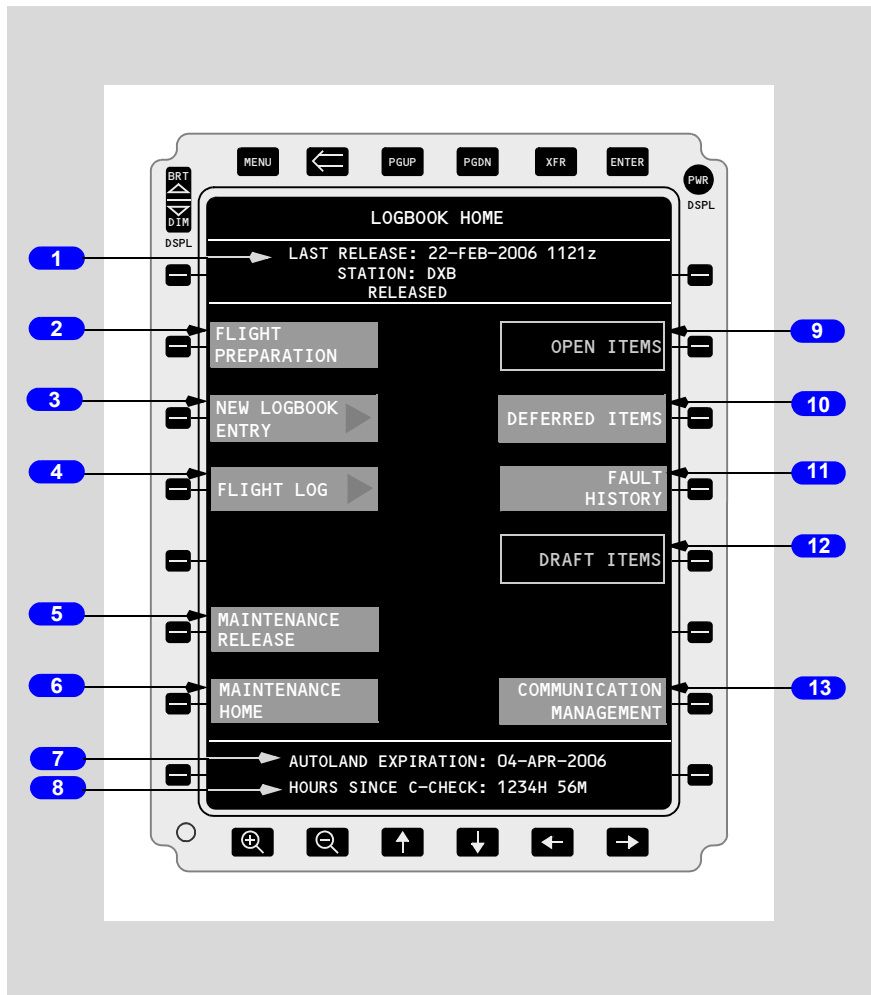
4 BRIGHT/CONTRAST

Changes the brightness and contrast of the image in the primary display as indicated by the + and - selections.

5 SHOW/HIDE MENU

- Selecting HIDE MENU removes the BRIGHT, CONTRAST, and MAINTENANCE menus
- After selecting HIDE MENU, the menu changes to SHOW MENU

Logbook (Typical)



1 Release Information

- Date and time of last release for flight
- Station where the last release occurred
- Current state of the airplane.

2 FLIGHT PREPARATION

Starts a guided process that prepares a flight log to document the upcoming flight. This function is intended to be used prior to flight.

3 NEW LOGBOOK ENTRY

Documents observed faults into the logbook. Uses a graphical fault finder tool that navigates through a series of images to identify selection of a fault. The purpose is to find the appropriate fault description and have it associated with the respective Fault Reporting Manual (FRM) fault code.

4 FLIGHT LOG

Displays the flight log for the current flight.

5 MAINTENANCE RELEASE

The maintenance release form has 2 pages plus a summary page. The first page includes information such as comments and release date. The second page allows the maintenance crew to document any restrictions associated with this release. Before a release can be signed, the user is required to review the summary page 3 contents of the maintenance release

6 MAINTENANCE HOME

The purpose of the maintenance home page is to provide maintenance crews a summary of the maintenance status of the airplane (release status, open & deferred item counts) and quick access to the maintenance functions. This page is accessible only when the airplane is in ground mode

7 AUTOLAND EXPIRATION

Displays the date and time the autoland currency expires.

8 HOURS SINCE C-CHECK

Displays the hours and minutes since the last C-check was accomplished.

9 OPEN ITEMS

Displays all open faults that have been documented for this airplane. It also includes any expired deferrals.

10 DEFERRED ITEMS

Displays all deferred faults reported for the airplane. On this page the user can view a brief description, the expiration of the deferral and an indication if any Maintenance (M) or Operational (O) procedures related to this deferral exist.

11 FAULT HISTORY

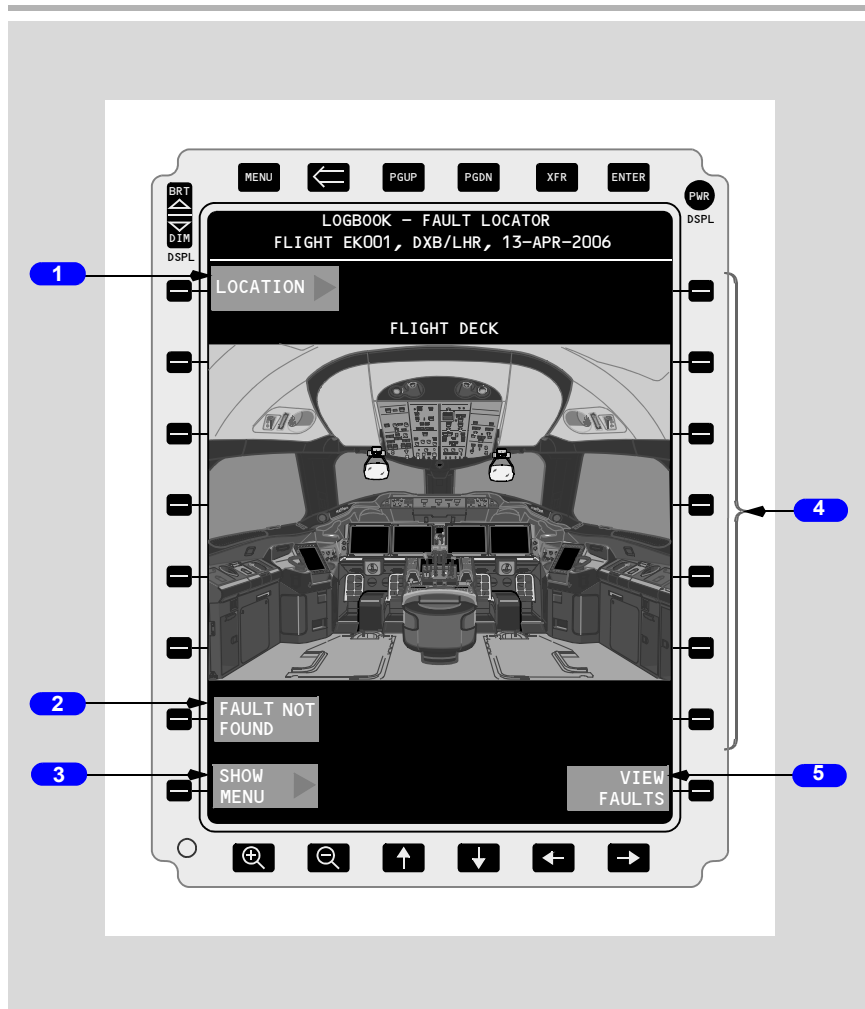
Lists all fault reports for the aircraft. It provides a description of the fault report plus the time it was reported and the current status. This list is organized by the DATE/TIME field.

12 DRAFT ITEMS

Provides the user with a view of all fault reports that have been created but not signed for official entry into the logbook. If a record has not been signed the user will have a choice of either signing the report to make it an official record, modify, or delete.

13 COMMUNICATION MANAGEMENT

Select to receive and send messages to the ground databases. All messages are sent over a secure link to ensure the integrity of the information.



1 LOCATION

Displays a list of airplane areas (Flight Deck, Engine, Exterior, etc.) for use in locating an area where a fault has occurred.

2 FAULT NOT FOUND

Displays a blank fault report form for the user to complete. This is required when a fault can not be found in the selected area.

3 SHOW/HIDE MENU

Toggle button that either shows or hides the extended menu selections.

4 Panel Selection Area

Selection of a boxed area navigates through a series of images to help identify a fault. The purpose is to narrow the search area to find the appropriate fault code.

5 VIEW FAULTS

Displays a list of all faults associated with the region displayed. The more the region is narrowed by selecting specific areas within a graphic, the fewer faults that are returned.

Intentionally
Blank

Flight Instruments, Displays
EICAS Messages**Chapter 10**
Section 70**Flight Instruments, Displays EICAS Messages**

Note: The OVERSPEED warning and the ALTITUDE ALERT caution messages are covered in Chapter 15, Warning Systems.

The following EICAS messages can be displayed.

Message	Level	Aural	Message Logic
ALTN ATTITUDE	Advisory		Both AIR DATA/ATTITUDE source switches are in the ALTN position.
BARO SET DISAGREE	Advisory		Captain's and first officer's barometric settings disagree.
DISPLAY SELECT PNL	Advisory		Left, center, or right CDU control of the display select panel is active.
EFIS CONTROL PNL L, R	Advisory		EFIS control panel is inoperative or CDU control of the EFIS control panel is active.
SGL SOURCE AIR DATA	Advisory		Both PFDs are receiving air data from the same single channel source.
SGL SOURCE DISPLAYS	Caution	Beeper	A single source of display information is being used by some or all display units.
SGL SOURCE RAD ALT	Advisory		Both PFDs are using the same source for radio altimeter information.
SINGLE SOURCE F/D	Advisory		Both PFDs are using the same source for flight director information.
VMO GEAR DOWN	Memo		Vmo value set for dispatch with landing gear extended.

Intentionally
Blank

Flight Management, Navigation**Chapter 11****Table of Contents****Section 0**

Controls and Indicators	11.10
Flight Management System	11.10.1
Control Display Unit (CDU)	11.10.1
Function and Execute Keys	11.10.4
Alpha/Numeric and Miscellaneous Keys	11.10.5
CDU Page Components	11.10.6
CDU Page Color	11.10.7
FMC Selector	11.10.10
Inertial System	11.10.10
Air Data Inertial Reference Unit (ADIRU)	11.10.10
Transponder	11.10.11
Transponder Panels	11.10.11
Weather Radar	11.10.16
Weather Radar Panels	11.10.16
Navigation Systems Description	11.20
Introduction	11.20.1
Navigation Systems Flight Instrument Displays	11.20.1
Global Positioning System (GPS)	11.20.1
GPS Displays	11.20.1
GPS Data	11.20.1
GPS System Schematic	11.20.2
Inertial System	11.20.3
Air Data Inertial Reference System (ADIRS)	11.20.3
Air Data Inertial Reference Unit (ADIRU)	11.20.3
Secondary Attitude and Air Data Reference Unit (SAARU) ..	11.20.4
Air Data and Attitude Sources	11.20.5
ADIRS Schematic, Normal Mode	11.20.7
ADIRS Schematic, With NAV ADIRU INERTIAL Message ..	11.20.9
Radio Navigation Systems	11.20.11
Automatic Direction Finding (ADF)	11.20.11

Distance Measuring Equipment (DME)	11.20.11
Instrument Landing System (ILS).	11.20.11
Navaid Identifier Decoding.	11.20.13
VOR	11.20.13
Transponder	11.20.14
Weather Radar	11.20.14
Flight Management System Description	11.30
Introduction	11.30.1
Flight Management Computer (FMC)	11.30.1
Control Display Units (CDUs).	11.30.2
Flight Management System Operation	11.31
Introduction	11.31.1
Preflight.	11.31.1
Takeoff	11.31.2
Climb.	11.31.2
Cruise	11.31.2
Descent	11.31.2
Approach.	11.31.2
Flight Complete.	11.31.2
Operational Notes.	11.31.2
Terminology	11.31.3
Maintenance Index	11.31.5
Navigation Position	11.31.6
FMC Position Update	11.31.6
FMC Polar Operations	11.31.7
Navigation Performance	11.31.9
Lateral Navigation (LNAV).	11.31.10
Waypoints	11.31.10
ND Map Displays	11.31.16
Vertical Navigation (VNAV).	11.31.17
Vertical Actual Navigation Performance (VANP)	11.31.17
Speed/Altitude Constraints	11.31.17

777 Flight Crew Operations Manual

Takeoff and Climb	11.31.19
Cruise	11.31.21
Mode Control Panel Speed Intervention	11.31.22
Descent	11.31.23
Early Descent	11.31.25
Approach	11.31.26
Missed Approach	11.31.27
Cruise and Descent Profile (Instrument Approach Using VNAV)	11.31.28
Takeoff and Climb (Engine Out)	11.31.30
Climb (Engine Out above EO Max Alt)	11.31.32
Cruise (Engine Out Above EO Max Alt)	11.31.32
Required Time of Arrival (RTA)	11.31.34
Data Entry Rules	11.31.34
Altitude Entry	11.31.34
Airspeed Entry	11.31.35
Data Pairs	11.31.35
Flight Management Computer	11.32
FMC Databases	11.32.1
Thrust Management	11.32.1
Reduced Thrust Takeoff	11.32.2
Derated Thrust Climb	11.32.3
Fuel Monitoring	11.32.4
Loss of FMC Electrical Power	11.32.5
FMC Failure	11.32.5
Single FMC Failure	11.32.5
Dual FMC Failure	11.32.6
Air Traffic Control Data Link	11.33
Air Traffic Control Data Link	11.33.1
Company Data Link	11.34
Company Data Link	11.34.1
Data Link	11.34.2

Uplinks	11.34.4
Data Link Management	11.34.10
CDU Data Link Status Displays	11.34.10
FMC Communications Page	11.34.11
FMC Preflight	11.40
Introduction	11.40.1
Preflight Page Sequence	11.40.1
Minimum Preflight Sequence	11.40.2
Supplementary Pages	11.40.2
Preflight Pages – Part 1	11.40.4
Initialization/Reference Index Page	11.40.4
Identification Page	11.40.6
Position Initialization Page 1/3	11.40.9
Position Reference Page 2/3	11.40.11
Position Reference Page 3/3	11.40.15
Route Page 1/X	11.40.17
Route Page 2/X	11.40.21
Departure/Arrival Index Page	11.40.23
Departures Page	11.40.25
Navigation Radio Page	11.40.27
Preflight Pages – Part 2	11.40.34
Performance Initialization Page	11.40.34
Thrust Limit Page	11.40.38
Takeoff Reference Page 1/2	11.40.42
Takeoff Reference Page 2/2	11.40.48
Menu Page	11.40.52
FMC Takeoff and Climb	11.41
Introduction	11.41.1
Takeoff	11.41.1
Climb	11.41.2
Altitude Intervention	11.41.2
Climb Page	11.41.2

777 Flight Crew Operations Manual

RTE X LEGS Page	11.41.7
Thrust Limit Page	11.41.10
Engine Out Climb	11.41.12
EO CLB Page	11.41.12
Engine Out Departure	11.41.13
Air Turnback	11.41.14
Arrivals Page	11.41.14
FMC Cruise.....	11.42
Introduction	11.42.1
LNAV Modifications	11.42.1
RTE LEGS Page Modifications	11.42.2
Add Waypoints	11.42.2
Delete Waypoints	11.42.3
Change Waypoint Sequence	11.42.4
Remove Discontinuities	11.42.5
Direct To And Intercept Course To	11.42.7
Intercept Course From	11.42.9
Select Desired Waypoint Page	11.42.11
Airway Intercept	11.42.12
Route Offset	11.42.15
Cruise Page	11.42.16
All Engine Cruise	11.42.16
Engine Out Cruise	11.42.18
VNAV Modifications	11.42.21
Cruise Climb	11.42.21
Planned Step Climb	11.42.21
Calculated Step Climb	11.42.22
Constant Speed Cruise	11.42.26
Cruise Descent	11.42.27
Early Descent	11.42.28
Navigation Data	11.42.28
Reference Navigation Data Page	11.42.28
Fix Information Page	11.42.31

Route and Waypoint Data	11.42.33
Route Data Page	11.42.33
Wind Data	11.42.35
Wind Page	11.42.36
Position Report Page	11.42.37
In-Flight Position Update	11.42.39
Progress Pages	11.42.41
Progress Page 1	11.42.41
Progress Page 2	11.42.44
RTA Progress Page 3	11.42.47
RNP Progress Page 4	11.42.50
FMC Descent and Approach	11.43
Introduction	11.43.1
Early Descent	11.43.1
Descent	11.43.1
Altitude Intervention	11.43.1
Descent Page	11.43.2
Descent Forecast Page	11.43.6
Offpath Descent Page	11.43.8
Engine Out Descent	11.43.10
Approach	11.43.10
Arrivals Page	11.43.10
Arrivals Page – IFR Approaches	11.43.12
Arrivals Legs Page	11.43.14
Procedure Hold (in lieu of procedure turn) Legs Page	11.43.15
Arrivals Page – VFR Approaches	11.43.15
Approach Reference Page	11.43.17
Alternate Airport Diversions	11.43.20
Alternate Page 1/2	11.43.20
Alternate List Page 2/2	11.43.23
XXXX Alternate Page	11.43.25
Holding	11.43.27
Holding Entry	11.43.28

777 Flight Crew Operations Manual

Hold Page (First Hold)	11.43.28
HOLD Page (Existing Hold)	11.43.32
FMS Alternate Navigation System Description.....	11.50
Introduction	11.50.1
Alternate Navigation Waypoints	11.50.1
Alternate Lateral Navigation	11.50.2
Alternate Navigation Radio Tuning	11.50.2
Alternate Navigation CDU Pages	11.50.2
Alternate Navigation Legs Page	11.50.3
Alternate Navigation Progress Page	11.50.4
Alternate Navigation Radio Page	11.50.6
EICAS Messages.....	11.60
Navigation EICAS Messages	11.60.1
FMC Messages	11.60.2
FMC Alerting Messages	11.60.2
FMC Communications Messages	11.60.5
FMC Advisory Messages	11.60.6
FMC Entry Error Messages	11.60.7
CDU Annunciator Lights	11.60.8

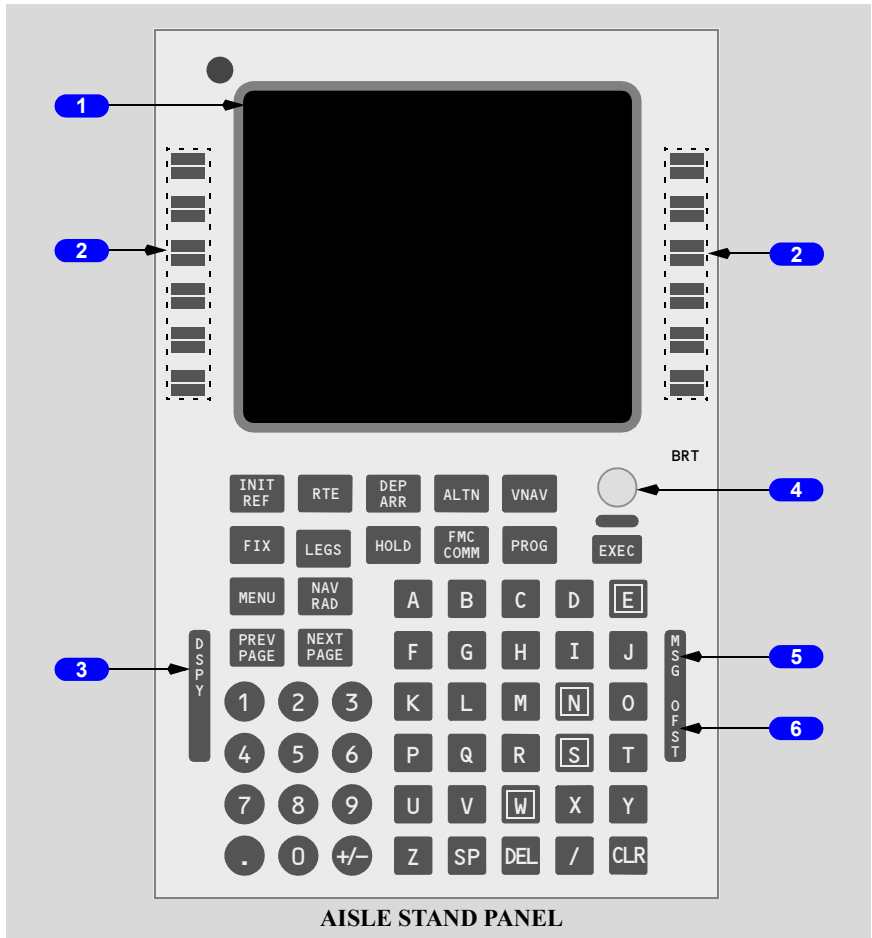
Intentionally
Blank

**Flight Management, Navigation
Controls and Indicators**

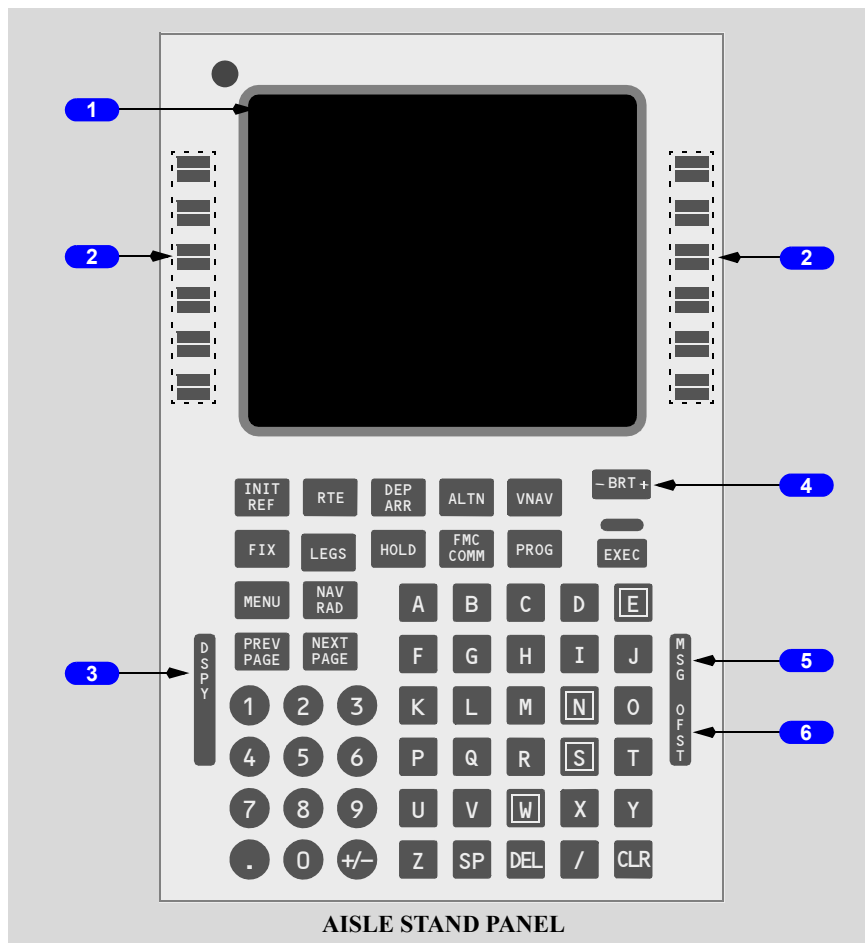
**Chapter 11
Section 10**

Flight Management System

Control Display Unit (CDU)



[CDU with rocker arm brightness control]



1 Control Display Unit (CDU) Display

Displays FMS data pages.

2 Line Select Keys

Push –

- moves data from scratchpad to selected line
- moves data from selected line to scratchpad
- selects page, procedure, or performance mode as applicable
- deletes data from selected line when DELETE displays in scratchpad.

Conventions -

- scratchpad must be blank for line select transfer
- data can not be transferred to a blank line
- a blank scratchpad can not be transferred to a line
- not all data can be modified
- message displays if inappropriate entries attempted.

3 Display (DSPY) Light

Illuminated (white) –

- when RTE page 3 or greater, RTE LEGS page 2 or greater, RTE DATA page 2 or greater is displayed
- when airplane is not in holding pattern shown on HOLD page
- when modification is in progress, and any RTE, RTE LEGS, RTE DATA, HOLD, or VNAV page is shown.

4 Brightness (BRT) Control

Rotate – controls display brightness.

4 Brightness (BRT) Control

Push –

- “+” increases brightness
- “-” decreases brightness
- 24 segment light brightness bar displays in the scratchpad and remains displayed for 2 seconds after release of the + or - push. Existing scratchpad information is saved and displays following fade of the brightness bar

5 Message (MSG) Light

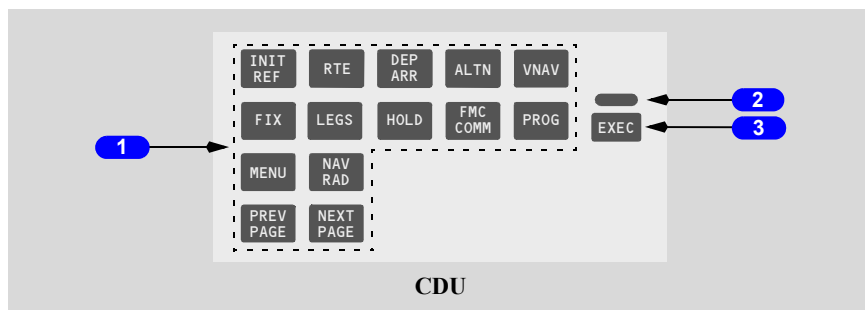
Illuminated (white) –

- scratchpad displays message
- pushing clear key extinguishes light and clears message.

6 Offset (OFST) Light

Illuminated (white) – LNAV gives guidance for lateral route offset.

Function and Execute Keys



1 CDU Function Keys

Push –

- INIT REF – displays page for data initialization or for reference data
- RTE – displays page to input or change origin, destination, or route
- DEP ARR – displays page to input or change departure and arrival procedures
- ALTN – displays page to modify destination and route for alternate diversion
- VNAV – displays page to view or change vertical navigation path data
- FIX – displays page to create reference points on ND map
- LEGS –
 - displays page to evaluate or modify lateral and vertical route data
 - displays page to correlate route waypoints on the ND
- HOLD – displays page to create holding patterns and display holding pattern data, or to exit holding pattern
- FMC COMM – displays FMC data link status page
- PROG – displays page to view dynamic flight and navigation data, including waypoint and destination ETAs, fuel remaining, arrival estimates, and RTA and RNP information
- MENU – displays page to choose subsystems controlled by CDU
- NAV RAD – displays page to view or control navigation radio tuning
- PREV PAGE – displays previous page of multiple page displays (for example, LEGS pages)
- NEXT PAGE – displays next page of multiple page displays.

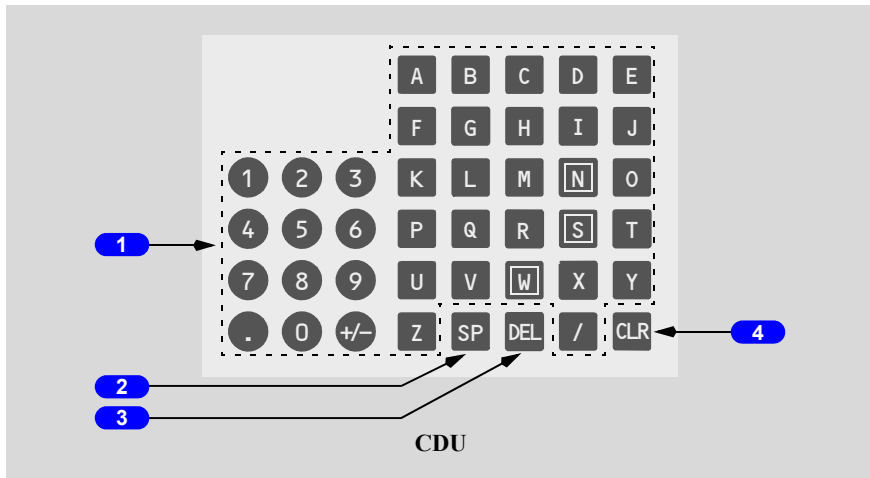
2 Execute Light

Illuminated (white) – active data is modified but not executed.

3 Execute (EXEC) Key

Push –

- activates data modification(s)
- extinguishes execute light.

Alpha/Numeric and Miscellaneous Keys**1 Alpha/Numeric Keys**

Push –

- puts selected character in scratchpad
- Slash (/) key – enters “/” in scratchpad
- Plus Minus (+/-) key – first push enters “-” in scratchpad. Subsequent pushes alternate between “+” and “-”.

2 Space (SP) Key

Push –

- enters space in scratchpad
- enters underscore character “_” in scratchpad when CDU is used as input device for systems other than FMC.

3 Delete (DEL) Key

Push – enters “DELETE” in scratchpad.

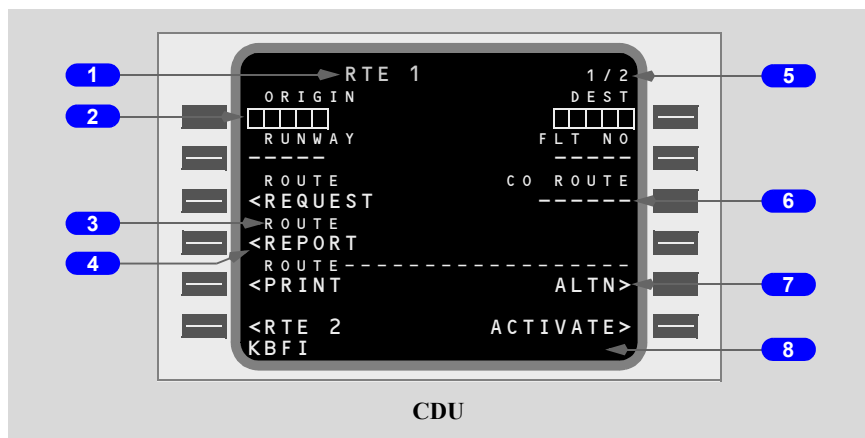
4 Clear (CLR) Key

Push –

- clears last scratchpad character
- clears scratchpad message.

Push and hold – clears all scratchpad data.

CDU Page Components



1 Page Title

Subject or name of data displayed on page.

ACT (active) or MOD (modified) indicates whether page contains active or modified data.

2 Boxes

Data input is mandatory.

3 Line Title

Title of data on line below.

4 Line

Displays –

- prompts
- selectors
- data associated with line title.

Large font indicates crew entered or verified data. Small font indicates FMC computed data.

5 Page Number

Left number is page number. Right number is total number of related pages. Page number is blank when only one page exists.

6 Dashes

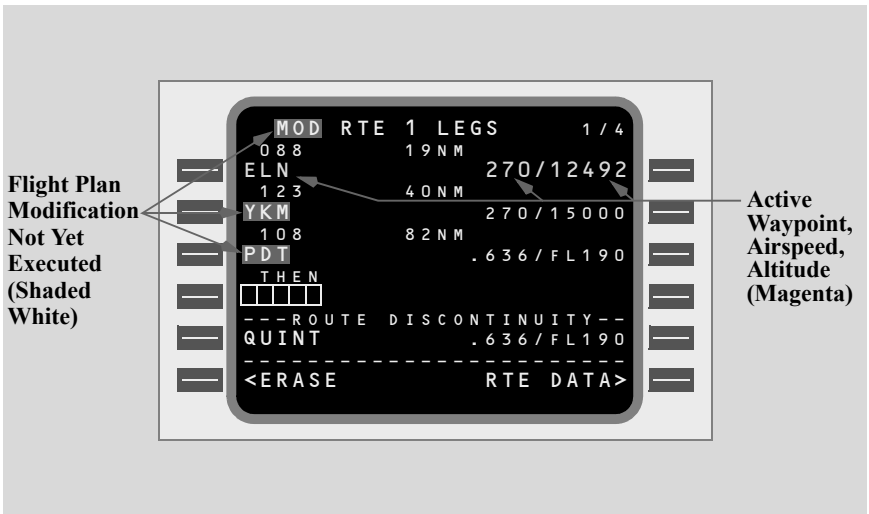
Data input is optional.

7 Prompts

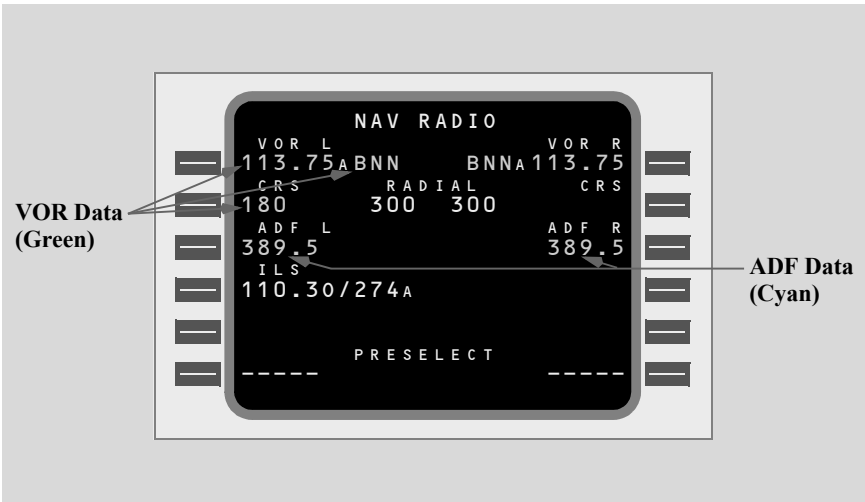
Display pages, select modes, and control displays. Caret "<" or ">" is before or after prompt.

8 Scratchpad

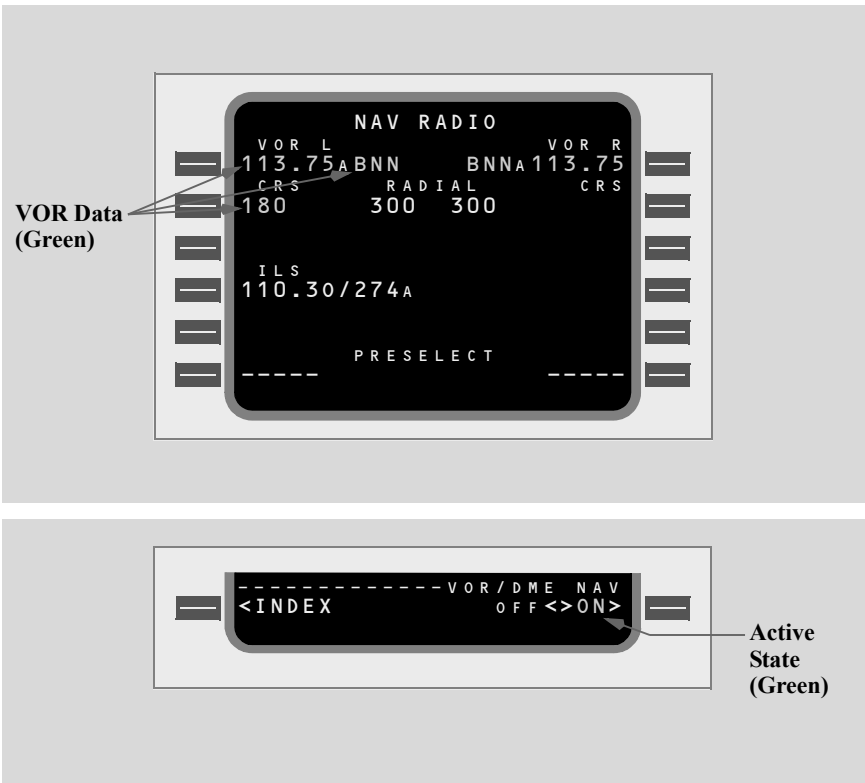
Displays messages, alphanumeric entries, or line selected data.

CDU Page Color

[Option: ADF installed]



[Option: ADF removed or not installed]



Color is used as follows:

- black – background color of page

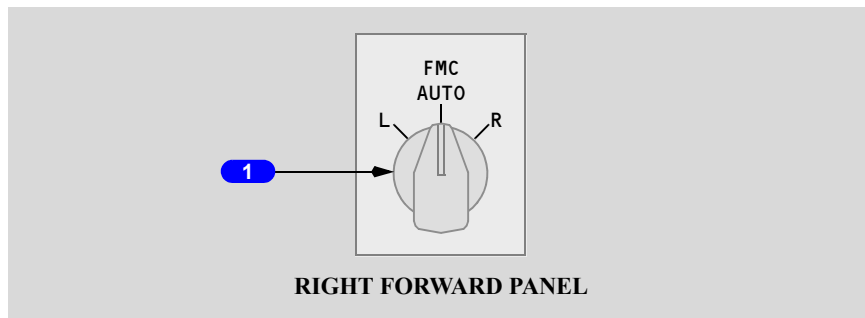
[Option: ADF installed]

- cyan –
 - ADF frequencies
 - inactive RTE page title

[Option: ADF removed or not installed]

- cyan –
 - inactive RTE page title
- green –
 - navigation radio data
 - active state of two–position and three–position selectors
- magenta – data used by FMC for lateral and vertical flight commands
 - active waypoint
 - active airspeed
 - active altitude
- shaded white –
 - modifications
 - MOD precedes page titles of modified pages
- white – most data.

FMC Selector



1 FMC Selector

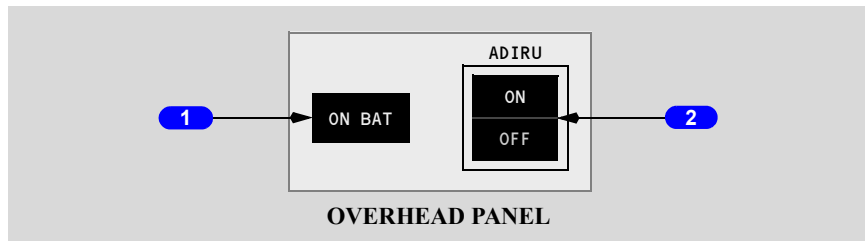
L – selects left FMC to provide guidance commands.

AUTO – automatically selects other FMC if one FMC fails.

R – selects right FMC to provide guidance commands.

Inertial System

Air Data Inertial Reference Unit (ADIRU)



1 On Battery (ON BAT) Light

Illuminated (white) – airplane battery powers ADIRU.

Note: ON BAT light illuminates only when ADIRU has been aligned on airplane or ground power, and primary power is subsequently removed or failed (battery power only remains).

2 ADIRU Switch

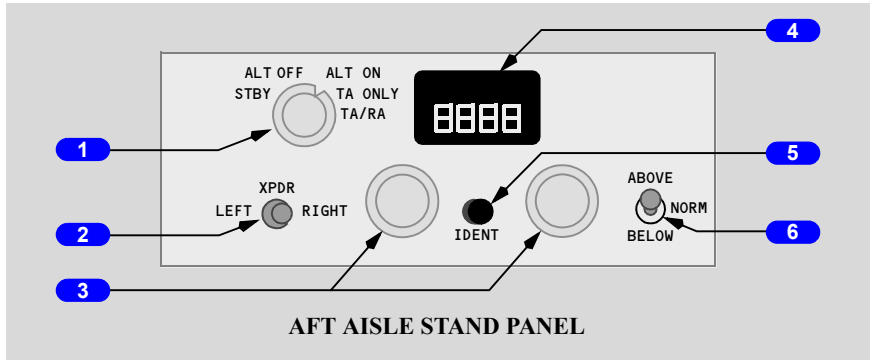
ON – applies power to ADIRU.

OFF – removes power when airspeed is less than 30 knots.

Transponder

Transponder Panels

[Option: Bendix 071-01503-2901]



1 Transponder Mode Selector

STBY (standby) – transponder disabled.

ALT OFF (altitude) –

- transponder enabled in modes A and S
- altitude reporting disabled

ALT ON (altitude) –

- transponder enabled in modes A, C, and S
- in flight, altitude reporting enabled

TA ONLY (traffic advisory) and TA/RA (traffic advisory/resolution advisory) – Refer to Chapter 15, Warning Systems.

2 Transponder (XPDR) Switch

LEFT – selects left transponder and ADIRU as source for transponder altitude reporting.

RIGHT – selects right transponder and SAARU as source for transponder altitude reporting.

3 Transponder Code Selectors

Rotate – sets transponder code.

4 Transponder Code Display

Displays transponder code.

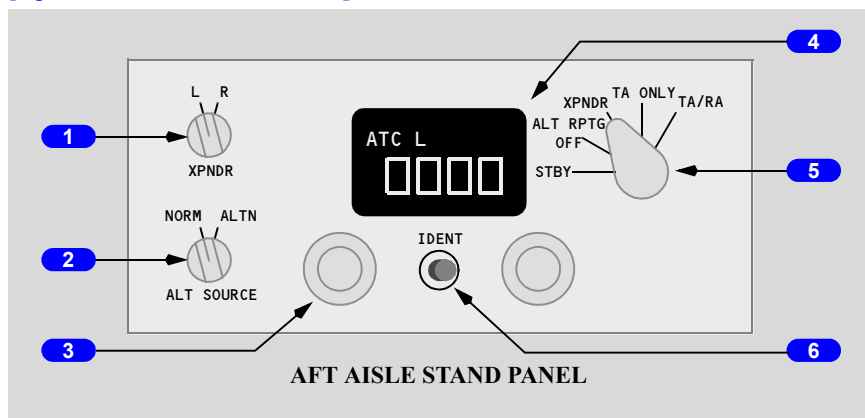
5 Identification (IDENT) Switch

Push – transmits ident signal.

6 TCAS Airspace Switch

Refer to Chapter 15, Warning Systems.

[Option: Gables G7131-01, -02]



1 Transponder (XPNDR) Selector

L – selects left transponder.

R – selects right transponder.

2 Altitude (ALT) SOURCE Selector

NORM (normal) – selects ADIRU as source for altitude reporting.

ALTN (alternate) – selects SAARU as source for altitude reporting.

3 Transponder Code Selectors

Rotate – Sets transponder code in transponder.

4 Transponder Code Window

ATC L, ATC R – transponder selected.

Displays transponder code.

5 Transponder Mode Selector

STBY (standby) – transponder not active.

ALT RPTG (altitude reporting) OFF –

- transponder enabled in modes A and S
- altitude reporting disabled

XPNDR (transponder) –

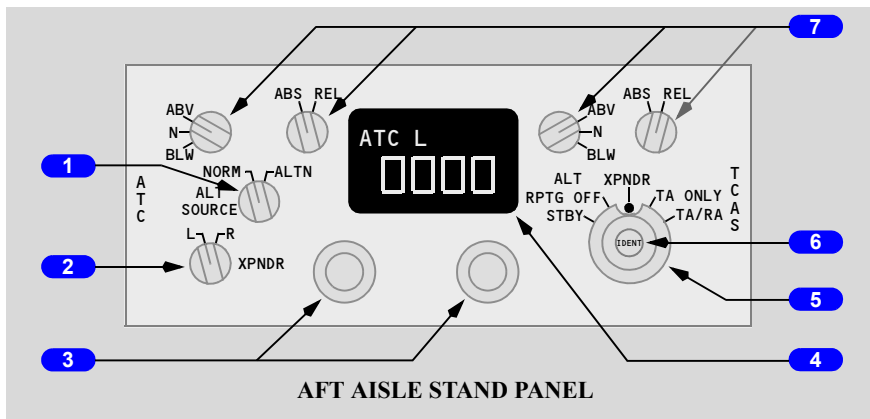
- transponder enabled in modes A, C, and S
- in flight, altitude reporting enabled

TA (traffic advisory) ONLY and TA/RA (resolution advisory) – Refer to Chapter 15, Warning Systems.

6 Identification (IDENT) Switch

Push – transmits an identification signal.

[Option: Gables G7131-03, -04]



1 Altitude (ALT) SOURCE Selector

NORM (normal) – selects ADIRU as source for altitude reporting.

ALTN (alternate) – selects SAARU as source for altitude reporting.

2 Transponder (XPNDR) Selector

L – selects left transponder.

R – selects right transponder.

3 Transponder Code Selectors

Rotate – Sets transponder code in transponder.

4 Transponder Code Window

ATC L, ATC R – transponder selected.

Displays transponder code.

5 Transponder Mode Selector

STBY (standby) – transponder not active.

ALT RPTG (altitude reporting) OFF –

- transponder enabled in modes A and S
- altitude reporting disabled

XPNDR (transponder) –

- transponder enabled in modes A, C, and S
- in flight, altitude reporting enabled

TA (traffic advisory) ONLY and TA/RA (resolution advisory) – Refer to Chapter 15, Warning Systems.

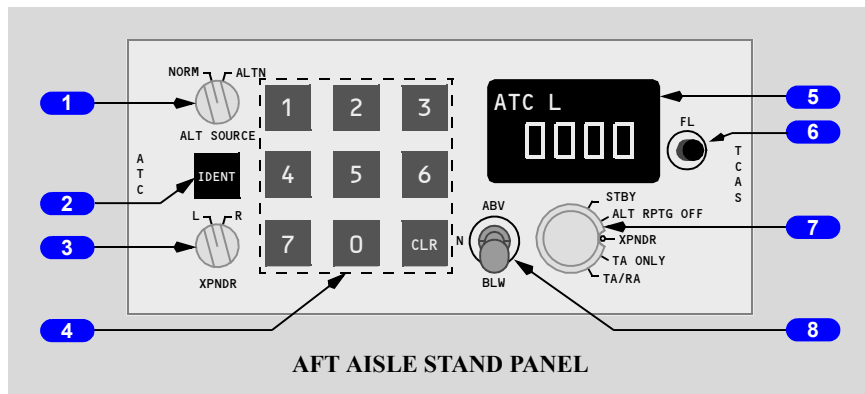
6 Identification (IDENT) Switch

Push – transmits an identification signal.

7 TCAS Controls

Refer to Chapter 15, Warning Systems.

[Option: Gables G7156-01]



1 Altitude (ALT) SOURCE Selector

NORM (normal) – selects ADIRU as source for altitude reporting.

ALTN (alternate) – selects SAARU as source for altitude reporting.

2 Identification (IDENT) Switch

Push – transmits ident signal.

3 Transponder (XPNDR) Selector

L – selects left transponder.

R – selects right transponder.

4 Transponder Code Switches

Push – sets transponder code.

5 Transponder Code Display

ATC L, ATC R – transponder selected.

Displays transponder code.

6 TCAS Flight Level (FL) Switch

Refer to Chapter 15, Warning Systems.

7 Transponder Mode Selector

STBY (standby) – transponder disabled.

ALT RPTG OFF (altitude reporting) –

- transponder enabled in modes A and S
- altitude reporting disabled

XPNDR (transponder) –

- transponder enabled in modes A, C, and S
- in flight, altitude reporting enabled

TA ONLY (traffic advisory) and TA/RA (traffic advisory/resolution advisory) –

Refer to Chapter 15, Warning Systems.

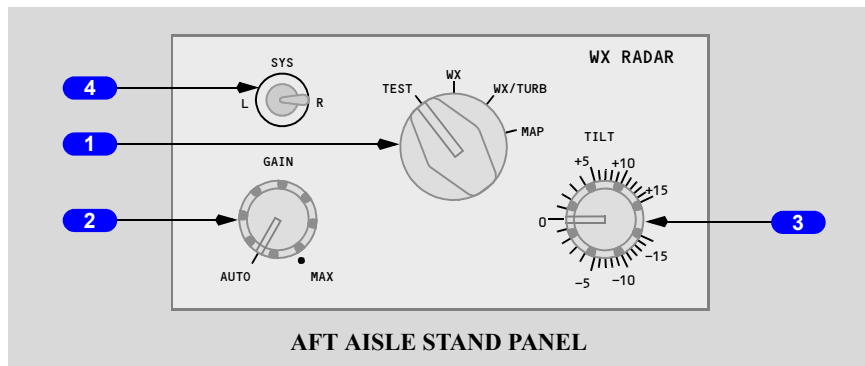
8 TCAS Airspace Switch

Refer to Chapter 15, Warning Systems.

Weather Radar

Weather Radar Panels

[Option – Bendix – Typical]



1 Mode Selector

Rotate – Selects mode and controls display on NDs.

TEST –

- tests weather radar system operation without transmitting
- displays test pattern and any fault message on ND with WXR selected (except in PLAN, CTR VOR, and CTR APP modes)
- when on the ground, selecting WXR on the EFIS control panel and TEST on the weather radar control panel activates an 8 second test. Initially, the EICAS alert message WINDSHEAR SYS displays. Next, the amber WINDSHEAR annunciation displays and the aural MONITOR RADAR DISPLAY sounds. Finally, the red WINDSHEAR annunciation displays and the aural GO AROUND WINDSHEAR AHEAD, and then WINDSHEAR AHEAD, WINDSHEAR AHEAD sounds
- the test pattern remains displayed until WXR is selected off on the EFIS control panel, another mode is selected on the Mode Selector, or an actual PWS alert is detected. The source of any faults displays in the weather radar tilt field on the ND.

WX (weather) – displays weather radar returns at selected gain level.

WX/TURB (turbulence) – displays weather radar returns and turbulence.

Turbulence display available with display ranges of 40 miles or less.

Note: Turbulence detection requires presence of detectable precipitation. Clear air turbulence cannot be detected by radar.

MAP – displays ground returns at selected gain level.

2 GAIN Control

Rotate – sets receiver sensitivity in WX, WX/TURB, and MAP modes.

AUTO (automatic) – maintains optimum receiver sensitivity.

3 TILT Control

Rotate clockwise – radar antenna tilts up to selected degrees from horizon.

Rotate counterclockwise – radar antenna tilts down to selected degrees from horizon.

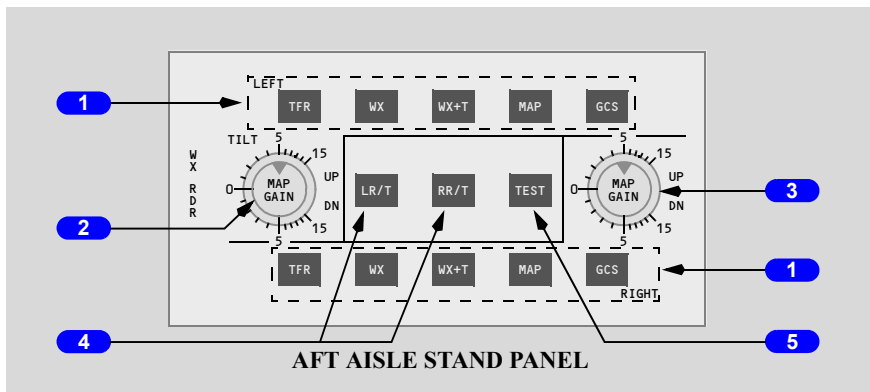
4 System (SYS) Switch

[Option: Bendix 2041220-0412]

Selects R/T for operation.

L or R – selects desired R/T.

[Option – Collins, Push-Button Mode Selection, Typical]

**1 Mode Switches**

Push – selects mode.

LEFT – controls displays on left ND.

RIGHT – controls displays on right ND.

TFR (transfer) – transfers other ND display selections to related ND.

Note: Selecting both TFR switches at the same time results in the TEST mode; test pattern displays.

WX – displays weather radar returns at selected gain level.

WX+T (turbulence) – displays weather returns and turbulence within precipitation at calibrated gain level. Turbulence display available with display ranges of 40 nm or less. Selecting a range greater than 40 nm changes mode to WX.

Note: Turbulence detection requires presence of detectable precipitation. Clear air turbulence cannot be detected by radar.

MAP – displays ground returns at selected gain level.

GCS (ground clutter suppression)

- IN – reduces amount of ground returns
- OUT – displays ground returns.

Note: Continuous operation is not recommended because weather return intensity may be reduced.

2 MAP GAIN Control

[Option: Collins 622-5130-205]

Rotate inner knob – sets receiver sensitivity in MAP mode on related ND. Full clockwise sets receiver sensitivity at the preset calibrated level.

3 Tilt Control

Rotate outer knob clockwise – tilts radar antenna up.

Rotate outer knob counterclockwise – tilts radar antenna down.

4 Receiver/Transmitter (R/T) Switches

Push -

- LR/T – selects left R/T. Pushes out RR/T switch.
- RR/T – selects right R/T. Pushes out LR/T switch

5 TEST Switch

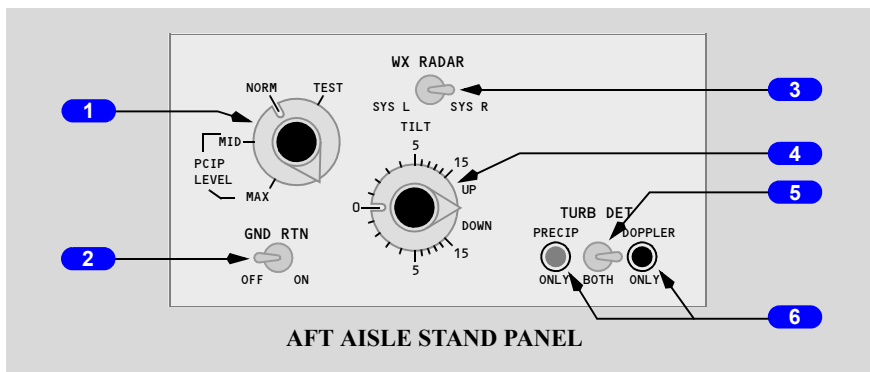
Push -

- tests weather radar system operation without transmitting
- displays test pattern and PWS symbol at the end of the test and any fault message on ND with WXR selected (except in PLAN, CTR VOR, and CTR APP modes).

777 Flight Crew Operations Manual

- when on the ground, selecting WXR on the EFIS control panel and TEST on the weather radar control panel activates a 12 second test. Initially, the amber WINDSHEAR annunciation displays and the aural MONITOR RADAR DISPLAY sounds. Next, the Master Warning Light illuminates and the EICAS alert message WINDSHEAR SYS displays. Finally, the red WINDSHEAR annunciation displays and the aural GO AROUND WINDSHEAR AHEAD, and then WINDSHEAR AHEAD, WINDSHEAR AHEAD sounds
- the test pattern and PWS symbol remain displayed until WXR is selected off on the EFIS control panel, another mode is selected on the Mode Selector, or an actual PWS alert is detected. The source of any faults displays in the weather radar tilt field on the ND.

[Option – Collins, Rotary Mode Selection, Typical]

**1 Mode Selector**

Rotate – Selects mode.

Precipitation (PCIP) LEVEL –

- MAX (maximum) – adjusts gain to maximum level
- MID (midway) – adjusts gain midway between calibrated and maximum level.

NORM – displays weather returns at preset calibrated gain level.

TEST-

- tests weather radar system operation without transmitting
- displays test pattern and PWS symbol at the end of the test and any fault message on ND with WXR selected (except in PLAN, CTR VOR, and CTR APP modes).

- when on the ground, selecting WXR on the EFIS control panel and TEST on the weather radar control panel activates a 12 second test. Initially, the amber WINDSHEAR annunciation displays and the aural MONITOR RADAR DISPLAY sounds. Next, the Master Warning Light illuminates and the EICAS alert message WINDSHEAR SYS displays. Finally, the red WINDSHEAR annunciation displays and the aural GO AROUND WINDSHEAR AHEAD, and then WINDSHEAR AHEAD, WINDSHEAR AHEAD sounds
- the test pattern and PWS symbol remain displayed until WXR is selected off on the EFIS control panel, another mode is selected on the Mode Selector, or an actual PWS alert is detected. The source of any faults displays in the weather radar tilt field on the ND.

2 Ground Return (GND RTN) Switch

OFF – returns radar to normal operating mode.

Note: Continuous operation is not recommended because weather return intensity may be reduced.

ON – reduces amount of ground returns.

3 RADAR Transfer Switch

Selects R/T for operation.

SYS L – selects left weather radar system.

SYS R – selects right weather radar system.

4 Tilt Control

Rotate clockwise – tilts radar antenna up.

Rotate counterclockwise – tilts radar antenna down.

5 Turbulence (TURB) Detection (DET) Switch

PRECIP (precipitation) ONLY – displays weather returns only.

BOTH – displays weather and turbulence returns.

DOPPLER ONLY – displays turbulence returns within precipitation with display ranges of 40 nm or less.

Note: Turbulence detection requires presence of detectable precipitation. Clear air turbulence cannot be detected by radar.

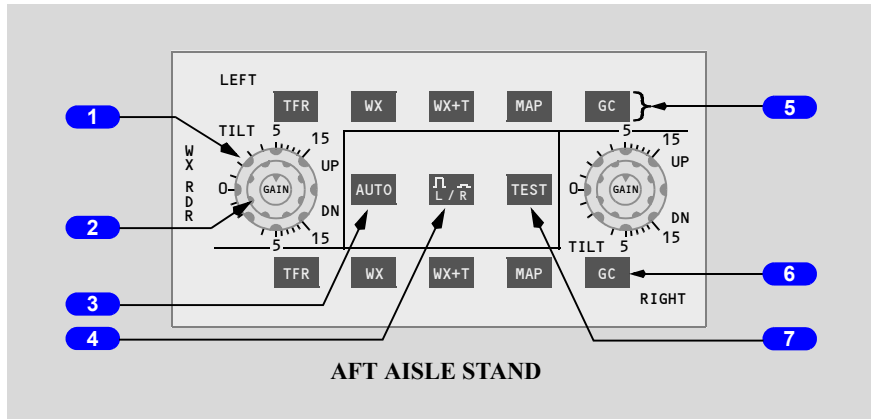
6 Turbulence Detection Lights

PRECIP ONLY (amber) – Turbulence detection switch set to PRECIP ONLY position.

777 Flight Crew Operations Manual

DOPPLER ONLY(amber) – Turbulence detection switch set to DOPPLER ONLY position.

[Option: Collins -622-5130-801]

**1 TILT Control**

Rotate outer knob clockwise – tilts radar antenna up.

Rotate outer knob counterclockwise – tilts radar antenna down.

2 GAIN Control

Rotate inner knob - adjusts receiver sensitivity (by detent) in MAP, WX, and WX+T modes. The 12 o'clock position sets radar sensitivity to the standard calibrated reflectivity level and is the recommended position for normal operation. Rotating the control clockwise increases sensitivity; rotating counterclockwise decreases sensitivity.

3 AUTO Switch

IN - both Captain's and First Officer's controls operate in automatic mode to optimize long and short range weather detection. Ground clutter suppression is operative. Manual tilt control is not available.

OUT - both Captain's and First Officer's controls operate manually. Ground clutter suppression is not available.

4 System Select Switch

IN - selects right system.

OUT - selects left system.

5 Mode Switches

Control display on respective ND.

Push -

TFR (transfer) - selects opposite display.

Note: Selecting both TFR switches at the same time results in the TEST mode; test pattern displays.

WX (weather) - displays weather returns.

WX + T (weather + turbulence) - displays weather returns and turbulence within precipitation. Turbulence displays out to 40 nm for all selected ranges.

Note: Turbulence detection requires presence of detectable precipitation. Clear air turbulence cannot be detected by radar.

MAP - displays ground returns at selected gain level.

6 Ground Clutter (GC) Switch

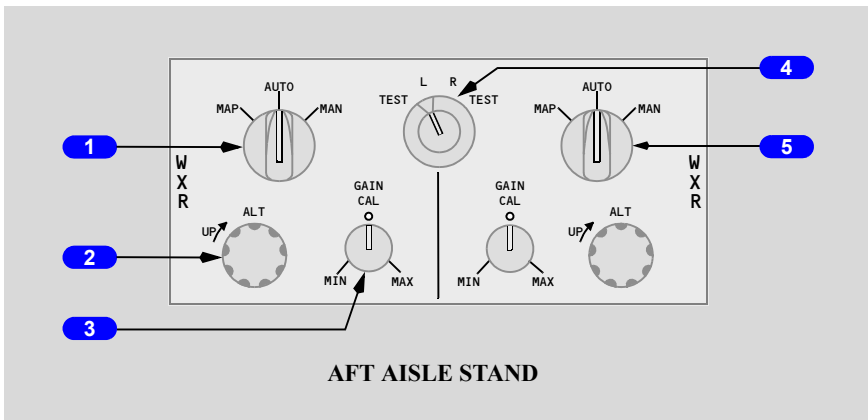
Push - allows ground clutter to display when pushed and held.

7 TEST Switch

Push –

- tests weather radar system operation without transmitting
- displays test pattern and PWS symbol at the end of the test and any fault message on ND with WXR selected (except in PLAN, CTR VOR, and CTR APP modes)
- when on the ground, selecting WXR on the EFIS control panel and TEST on the weather radar control panel activates a 12 second test. To activate the aural messages, TEST must be selected after WXR is selected on the EFIS control panel. Initially, the amber WINDSHEAR annunciation displays and the aural MONITOR RADAR DISPLAY sounds. Next, Master Warning Light illuminates and the EICAS alert message WINDSHEAR SYS displays. Finally, the red WINDSHEAR annunciation displays and the aural GO AROUND WINDSHEAR AHEAD, and then WINDSHEAR AHEAD, WINDSHEAR AHEAD sounds
- the test pattern and PWS symbol remain displayed until WXR is selected off on the EFIS control panel, another mode is selected on the Mode Selector, or an actual PWS alert is detected. The source of any faults displays in the weather radar tilt field on the ND

[Option: Honeywell RDR4000]

**1 Captain's Mode Selector**

Map – displays full coverage ground map.

AUTO – displays weather presentation.

MAN – displays constant altitude weather presentation.

2 Altitude Selector

Rotating clockwise raises the layer of weather return by 1000 feet per click.

Rotating counterclockwise lowers the layer of weather return by 1000 feet per click. Active when MAN mode selected.

3 Gain Selector

Rotate to vary the weather presentation gain. CAL position automatically sets standard thresholds. In AUTO or MAN mode, rotating the selector toward MIN reduces precipitation intensity thresholds requiring greater intensity precipitation levels to display in red. Rotating the selector toward MAX increases precipitation intensity thresholds allowing lesser intensity precipitation levels to display in red. MAX gain should only be used at cruise altitudes to help see less reflective frozen storm tops.

4 System Selector

Rotate – selects left or right radar system. When changing the selection, display of weather data may be slightly delayed. This is due to refreshing the radar memory buffer.

TEST – with WXR selected on at least one EFIS Control panel, places radar system in test mode. When selecting TEST, weather radar panel lighting increases to full bright, dims, then returns to the brightness setting selected prior to selecting TEST.

Time TEST Selected	Approximately 2 Seconds	Approximately 4 Seconds	Approximately 6 Seconds
PWS FAIL/INOP	On	OFF ("ON" if failure detected)	
PWS VISUAL ALERTS	Off	Amber WINDSHEAR on both NDs	Red WINDSHEAR on both NDs and PFDs
PWS AURAL ALERTS	None	Tone "Monitor Radar Display"	"Go Around, Windshear Ahead, Windshear Ahead, Windshear Ahead"
DISPLAY	Normal Test Pattern (No PWS Icon)		

No fault indications shown after completion of the test sequence indicates full radar system operation is available.

Left (L) – selects number one transmitter/receiver for normal weather operation.

Right (R) – selects number two transmitter/receiver for normal weather operation.

5 First Officer's Mode Selector

Map – displays full coverage ground map.

AUTO – displays weather presentation.

MAN – displays constant altitude weather presentation.

Flight Management, Navigation
Navigation Systems Description**Chapter 11**
Section 20

Introduction

Navigation systems include global positioning system (GPS), air data inertial reference system (ADIRS), VOR, DME, ILS, ADF, ATC transponder, weather radar, and the flight management system (FMS). The FMS is described in the Flight Management System Description section of this chapter.

Navigation systems include global positioning system (GPS), air data inertial reference system (ADIRS), VOR, DME, ILS, ATC transponder, weather radar, and the flight management system (FMS). The FMS is described in the Flight Management System Description section of this chapter.

Navigation Systems Flight Instrument Displays

Refer to Chapter 10, Flight Instruments, Displays for flight instrument display system operations and typical instrument displays.

Global Positioning System (GPS)

Left and right GPS receivers are independent and supply very accurate position data to the FMC. GPS tuning is automatic.

GPS Displays

POS REF 3/3 page displays the left and right GPS position. The ND annunciates GPS when the FMC uses GPS position updates.

When the POS (position) switch on the EFIS control panel is selected, the ND map displays the left and right GPS symbols. The GPS symbols are identical and display as a single symbol when the GPS receivers calculate the same position.

GPS Data

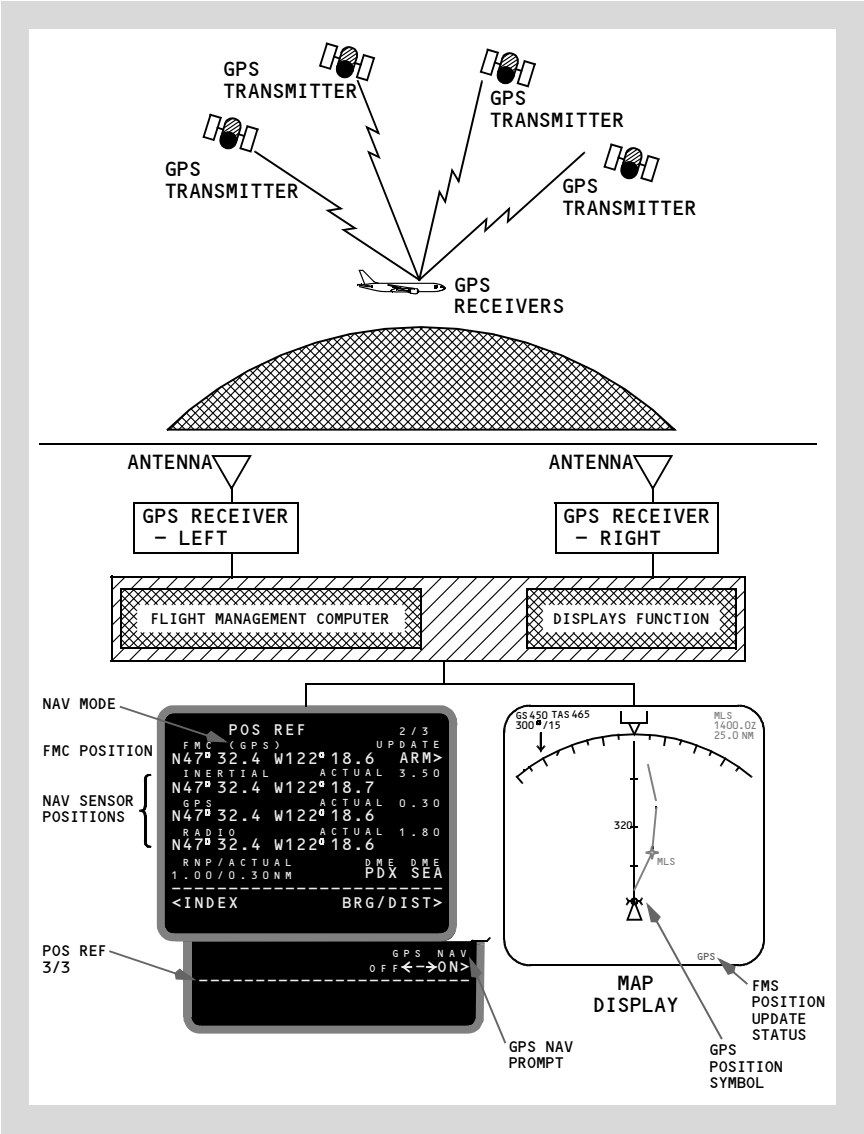
If the ADIRU becomes inoperative during flight, the EICAS displays the message NAV ADIRU INERTIAL and the FMC uses only GPS data to navigate.

Use the GPS NAV prompt on the POS REF page to inhibit GPS navigation data. The EICAS message GPS alerts the crew when data from both GPS systems are unavailable or when both systems have failed.

GPS position updates should be used during all approaches in which the FMC database and approach procedures are referenced to the WGS-84 reference datum. GPS updates should be inhibited for other approach operations not based on WGS-84 unless other appropriate procedures are used.

GPS position updates should be used for all other operations unless a specific state requires the use of other update provisions within their airspace (eg, to accommodate a non-WGS reference datum or other reason).

GPS System Schematic



Inertial System

Air Data Inertial Reference System (ADIRS)

The ADIRS calculates airplane altitude, airspeed, attitude, heading, and position data for the displays, flight management system, flight controls, engine controls, and other systems. The major components of ADIRS are the air data inertial reference unit (ADIRU), secondary attitude and air data reference unit (SAARU), and air data modules.

Air Data Inertial Reference Unit (ADIRU)

The ADIRU supplies primary flight data, inertial reference, and air data. The ADIRU is fault-tolerant and fully redundant.

ADIRU Power

Initial power-up requires battery bus power and the ADIRU switch to be ON. If the ADIRU is switched off, it must complete a full realignment cycle before the airplane can be moved.

If electrical power is subsequently removed from the airplane and the Battery switch is switched OFF, the hot battery bus continues to supply electrical power to the ADIRU. The ON BAT light illuminates, and the horn in the landing gear wheel well sounds to alert maintenance personnel the ADIRU is on battery power.

When the ADIRU switch is OFF, the ADIRU remains powered for a few seconds.

In flight, system logic prevents the ADIRU from becoming unpowered if the ADIRU switch is inadvertently switched OFF.

ADIRU Alignment

On initial power-up, the ADIRU enters the align mode. The EICAS memo message ADIRU ALIGN MODE displays. Attitude or heading/track data is removed from the PFDs. Airplane latitude/longitude position must be entered on the CDU POS INIT page. The airplane should not move until alignment is complete.

If the latitude/longitude position is not close to the position of the origin airport, the scratchpad message INERTIAL/ORIGIN DISAGREE displays. If the crew-entered latitude/longitude position does not pass internal ADIRU comparison tests, the scratchpad message ENTER INERTIAL POSITION displays.

If a new airplane present position entry fails the internal check twice, the scratchpad message ALIGNMENT REINITIATED displays. The system automatically starts a new alignment cycle.

In rare cases, a new airplane present position update of the ADIRU may cause the EICAS message NAV UNABLE RNP to momentarily display. This occurs if the entered ADIRU position is far different than the GPS position. The message displays until the FMC reconciles the difference between the new ADIRU position and the GPS position.

When the alignment is complete, the ADIRU changes to the navigate mode and the airplane can be moved. If the airplane stops for an extended period, the ADIRU changes to the automatic realign mode and refines the alignment until the airplane moves again.

In the automatic realign mode, ADIRU velocity and acceleration errors are reset to zero. The inertial position can be manually updated when the ADIRU is in the automatic realign mode by entering a new latitude/longitude position on the POS INIT 1/3 page. The ADIRU cannot be realigned in flight.

Note: A position update is recommended if the total time in the navigation mode is expected to exceed 24 hours.

Secondary Attitude and Air Data Reference Unit (SAARU)

The SAARU is a secondary source of critical flight data for displays, flight control systems, and other systems. If the ADIRU fails, the SAARU automatically supplies attitude, heading, and air data. SAARU heading must be manually set to the standby compass magnetic heading periodically.

If ADIRU inertial data fails, the EICAS caution message NAV ADIRU INERTIAL displays. The SAARU supplies attitude data to the PFD and three minutes of backup heading. The heading is based on ADIRU heading prior to failure. The CDU POS INIT page displays the SET HDG prompt three minutes after ADIRU failure. Use the SET HDG prompt to periodically set the SAARU heading to the standby compass magnetic heading. There are no other prompts to remind the crew to enter or to update the SAARU heading.

The following functions are inoperative after failure of the inertial reference portion of the ADIRU:

AFDS Modes:

- LNAV
- VNAV
- TO/GA
- LOC
- GS
- FPA
- TRK HOLD/SEL
- HDG HOLD/SEL*

Navigation Functions:

- FMC VNAV pages
- FMC Performance Predictions
- ND Wind Direction and Speed (wind arrow)

PFD Functions:

- Flap Maneuver Speeds
- PFD Heading*

Note: *This function is operative when standby magnetic compass heading is entered on the POS INIT page.

Note: ND map mode display following ADIRU failure references TRK.

Note: The autobrake is also inoperative.

The following additional functions are inoperative after failure of the inertial reference portion of the ADIRU and loss of GPS information:

- ND Map (center and expanded)
- CDU active leg course and distance
- CDU direct-to a waypoint
- FMC Alternate Airport DIVERT NOW
- FMC navigation radio autotuning

Restoration of the SAARU heading allows navigation in the ND VOR mode using radio navigation data. The FMC navigation data LNAV/VNAV guidance is no longer available when the ADIRU fails.

[Option - without ISFD]

The SAARU supplies the only source of attitude data to the standby attitude indicator display.

SAARU power-up is completely automatic at airplane power-up. There are no SAARU controls.

Air Data and Attitude Sources

The ADIRU and SAARU receive air data from the same three sources. The ADIRU and SAARU validate the air data before it may be used for navigation.

The three air data sources are the left, center, and right pitot and static systems. Air data is valid when two or more sources agree in the ADIRU, SAARU, or both.

When ADIRU air data is invalid and the AIR DATA/ATT switch is in the off position, valid SAARU air data is used. Refer to Chapter 10, Flight Instruments, Displays for a description of the AIR DATA/ATT switch.

Single channel operation occurs when the ADIRU and SAARU air data are invalid. The left PFD displays the ADIRU air data from the left pitot static system (left channel). The right PFD displays the SAARU air data from the right pitot static system (right channel). The EICAS message NAV AIR DATA SYS displays.

The air data modules are remote sensors for the air data functions within the ADIRU and SAARU. They measure static and pitot pressure. Both the ADIRU and SAARU receive data from all air data modules. In addition, the ADIRU and SAARU each receive data from the two angle of attack vanes and a dual element total air temperature probe.

[Option - Without ISFD]

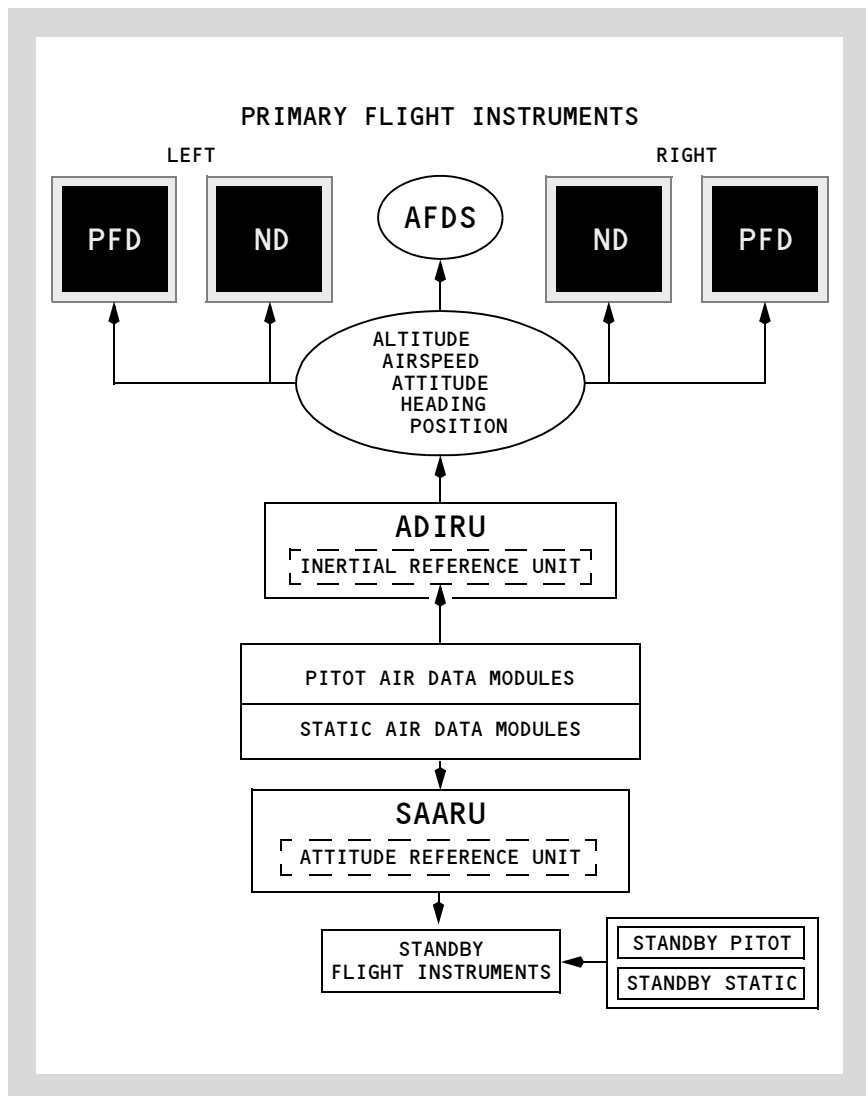
The standby flight instrument displays receive data from the center pitot and static ports through standby air data modules. Altitude and airspeed are independent of ADIRU and SAARU values. SAARU provides attitude information.

[Option - With ISFD]

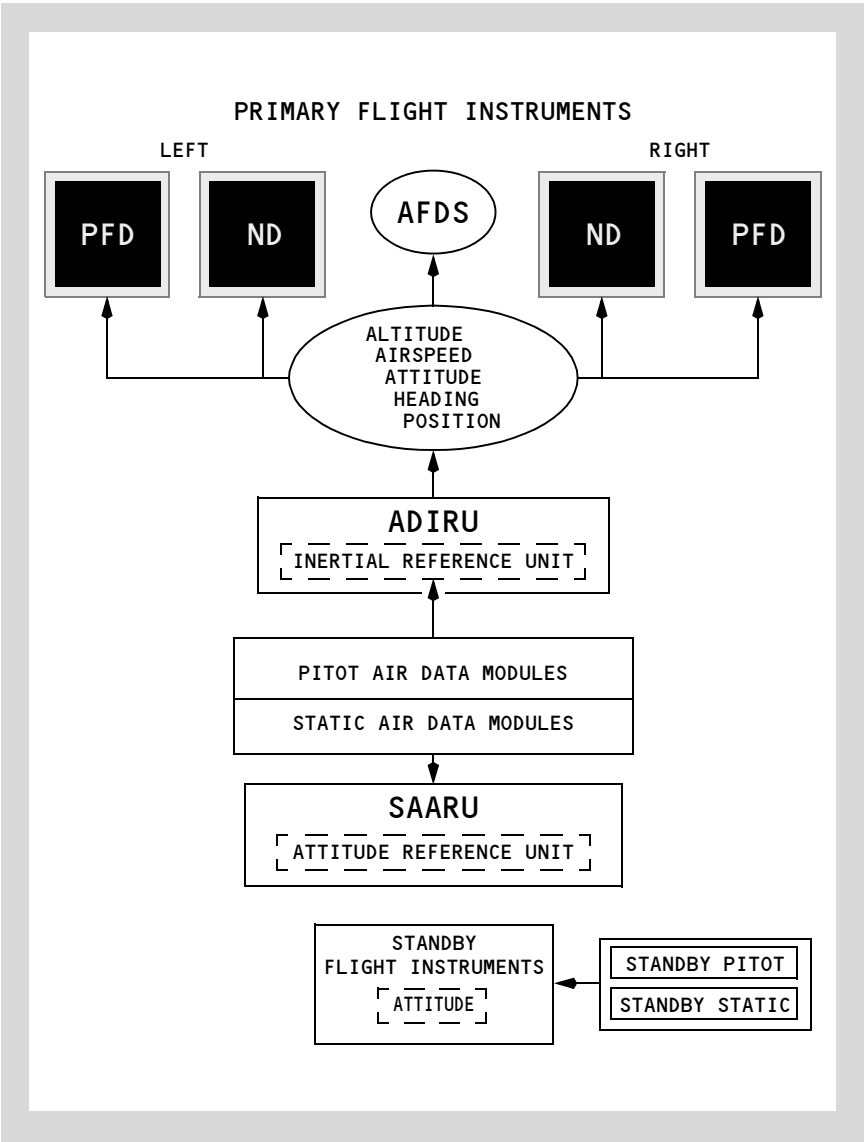
The standby flight instrument displays receive data from the center pitot and static ports through standby air data modules. Altitude, attitude, and airspeed are independent of ADIRU and SAARU values.

ADIRS Schematic, Normal Mode

[Option - Without ISFD]

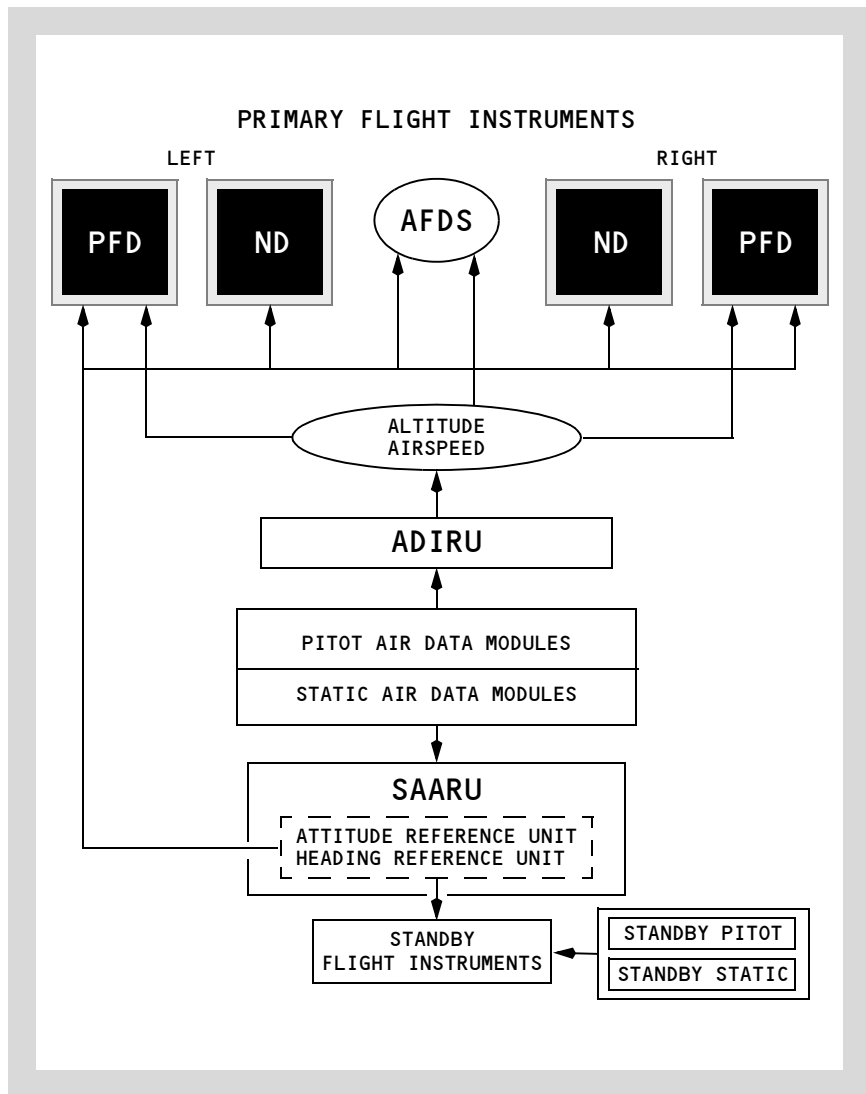


[Option - With ISFD]

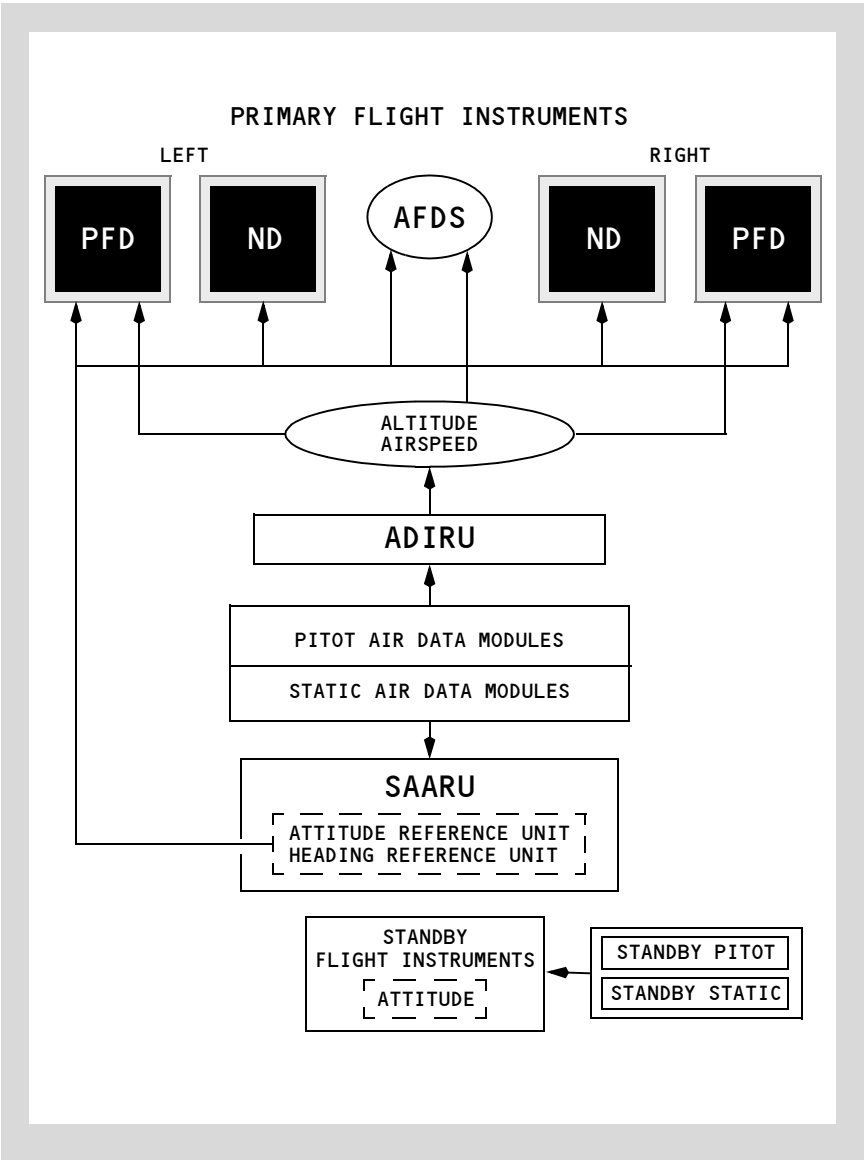


ADIRS Schematic, With NAV ADIRU INERTIAL Message

[Option - Without ISFD]



[Option - With ISFD]



Radio Navigation Systems

Automatic Direction Finding (ADF)

Two ADF systems are installed. Either ADF can be manually tuned from the left or right CDU on the NAV RADIO page.

ADF Displays

Left and right ADF bearings display on the ND when the related VOR/ADF switch is in the ADF position. ADF data is cyan.

If both FMCs fail, the left and right ADF radios are tuned on the related left and right CDU ALTN NAV RADIO page.

Distance Measuring Equipment (DME)

Two DME systems are installed. The DMEs are usually tuned by the FMC, but may be tuned manually.

DME Tuning

DME is tuned manually when the VOR portion of a VOR/DME pair is entered on the NAV RADIO page. The FMC tunes DME as necessary for radio position updates. Manual DME tuning does not inhibit FMC DME tuning.

The FMC uses two DMEs for position updates. DME/DME position updates are usually more accurate than VOR/DME updates. The FMC cannot tune specific DMEs if the nav aids are inhibited on the REF NAV DATA page.

After dual FMC failure, the left DME is tuned with the left CDU and the right DME is tuned with the right CDU. Each DME is tuned to the VOR displayed on the CDU unless the related EFIS control panel ND mode selector is set to APP. In APP, the DME is tuned to the ILS.

DME Displays

DME distance displays on the ND map when operating in the VOR mode. DME distances also display when the ND mode selector is in the VOR or APP position, and either or both VOR L or VOR R switches are selected. DME distance also displays on the PFD when the ILS receivers are tuned to a collocated DME and localizer facility.

POS REF page 2/3 displays the identifiers of the DME stations used for FMC position updates.

Instrument Landing System (ILS)

Three ILS receivers are installed. They are usually tuned by the FMC, but can be tuned manually on the NAV RADIO page.

ILS Tuning

Two conditions must be met for FMC ILS autotuning to occur:

- an ILS, LOC, back course, LDA (localizer–type directional aid), or SDF (simplified directional facility) approach have been selected to the active route, and
- the airplane is within 50 NM from the top of descent, 150 NM of the landing runway threshold, or the FMC is in descent mode

On initial takeoff, ILS autotuning is inhibited for 10 minutes to prevent clutter on the PFD. Selection and execution of a new approach in the active flight plan causes the ILS to autotune to the new approach frequency, even if this is accomplished during the 10 minute takeoff inhibit period. ILS autotune inhibit does not apply to subsequent takeoffs on the same flight (for example, touch-and-go or stop-and-go landings).

All three ILS receivers can be manually tuned from the NAV RADIO page at anytime unless ILS approach tuning inhibit is active.

ILS approach tuning inhibit is active when:

- the autopilot is engaged and either the localizer or glideslope is captured
- Only the flight director is engaged, and either the localizer or the glideslope is captured, and the airplane is below 500 feet radio altitude, or
- on the ground, the localizer is alive, airplane heading is within 45 degrees of the localizer front course, and ground speed is greater than 40 knots

ILS tuning is again enabled when:

- either TOGA switch is pushed
- the autopilot is disengaged and both flight director switches are switched off, or
- the MCP approach mode is deselected above 1500 feet radio altitude

The ILS frequency is automatically retuned when ILS tuning is enabled and a new approach is selected on the CDU.

After dual FMC failure, the left and center ILS receivers are tuned with the left CDU on the ALTN NAV RADIO page. The right ILS receiver is tuned with the right CDU on the ALTN NAV RADIO page.

ILS Displays

The tuned ILS frequency displays on the PFD and on the ND in the approach mode.

Localizer and glideslope deviation display on the PFD. Localizer and glideslope deviation, and selected course display on the ND when that ND is in the approach mode. Front or back course deviation is determined from airplane heading.

Navaid Identifier Decoding

The Morse code identifier of a tuned VOR, ILS, DME, or ADF can be converted to alpha characters. The decoded identifier then displays on the PFD and ND. The crew should monitor this identifier for correct navigation radio reception. The identifier name is not compared with the FMC data base.

The Morse code identifier of a tuned VOR, ILS, or DME can be converted to alpha characters. The decoded identifier then displays on the PFD and ND. The crew should monitor this identifier for correct navigation radio reception. The identifier name is not compared with the FMC data base.

Due to the large variation in ground station identifier quality, the decode feature may incorrectly convert the intended identifier name. Examples: the Hong Kong localizer “KL” may display as “KAI”, or the Boeing Field ILS may display as “QBFI” or “TTTT” instead of “IBFI.”

Pilots should verify the identity of the tuned navigation station from the audio Morse code when the tuned frequency remains displayed or an incorrect identifier displays.

VOR

Two VOR receivers are usually tuned by the FMC but, can be tuned manually by the crew. The tuned VORs display on the ND and may be used for position updates.

VOR Tuning

The crew manually tunes VORs on the NAV RADIO page.

The FMC can tune a VOR and a collocated DME for position updates. The FMC uses VOR/DME radio position updates when more accurate sources are not available. Specific VOR/DME pairs can be inhibited on the REF NAV DATA page. If the crew enters two VOR identifiers on the NAV RADIO page, then the FMC cannot tune any other station for VOR/DME updates.

After dual FMC failure, the VOR radios can be manually tuned on the CDU ALTN NAV RADIO page. The left VOR is tuned with the left CDU and the right VOR is tuned with the right CDU.

VOR Displays

The NAV RADIO page displays FMC–tuned or manually–tuned VOR data. POS REF page 2/3 displays the identifier of the VOR and DME pair used for position updates.

The ND displays the identifier or frequency of the VORs tuned on the NAV RADIO page. The FMC usually tunes the same VOR in the left and the right. The ND VOR L VOR R data are usually the same.

Left and right VOR bearings display on the ND map when the related EFIS control panel VOR/ADF switch is in the VOR position. VOR bearings also display when the ND mode selector is in the VOR or APP position, and either or both VOR L or VOR R switches are selected. The VOR frequency and selected course display in the upper right hand corner of the ND when operating in the VOR mode. The ND also displays course deviation when operating in the VOR mode.

Transponder

The transponder panel controls two ATC transponders and the traffic alert and collision avoidance system (TCAS). Traffic displays if the transponder mode selector is in TA ONLY or TA/RA. The transponder responds to Mode S interrogations in all modes except STBY. In flight, the selected transponder activates beacon and altitude reporting when the transponder mode selector is in XPNDR, TA ONLY, or TA/RA. The EICAS advisory message TRANSPONDER L or TRANSPONDER R displays if a transponder fails. If altitude reporting fails, the transponder can be switched to the alternate altitude source. Refer to Chapter 15, Warning Systems, for a description of TCAS.

Transponders provide selective interrogation and downlink information, such as flight number, airspeed or groundspeed, magnetic heading, altitude, GPS position, etc., depending on the level of enhancement. Some airports use transponder information to monitor airplane position on the ground when the transponder is active (mode selector not in STANDBY or OFF). Transponder enhancements also enable air traffic controllers in some areas of the world to use Automatic Dependent Surveillance-Broadcast (ADS-B). TCAS modes should not be used on the ground for ground tracking.

Weather Radar

The weather radar system consists of receiver–transmitter unit, antenna, and control panel. Radar returns display on the ND in all modes except:

- plan
- VOR center
- approach center

The EFIS control panel weather radar (WXR) map switch controls power to the transmitter/receiver and controls the weather radar display on the ND. The radar display range automatically adjusts to the ND range selected on the EFIS control panel.

The weather radar system performs various levels of self test on power up, during each sweep, and when descending through 2,300 feet AGL.

Multiscan weather radars collect data from different scans and merge the information into a total weather picture. Special software eliminates ground clutter resulting in clutter-free viewing of significant weather out to 320 nm. When operating in the automatic mode, multiple radar scans at pre-selected tilt angles detect short, mid, and long range weather. Tilt and gain inputs are not required. This results in weather detection at all ranges and in all phases of flight. Additional processing ensures data from thunderstorm tops within 5,000 feet of the airplane remain on the radar display until it no longer poses a danger; thus, enabling flight around thunderstorms that may not be visible otherwise.

The CDU can control the EFIS control panel functions, including the WXR. The weather radar operating modes and fault conditions display on the ND.

Turbulence can be sensed by the weather radar only when there is sufficient precipitation. Clear air turbulence can not be sensed by radar.

The weather radar also provides predictive windshear alerting (refer to Chapter 15, Warning Systems).

Intentionally
Blank

Flight Management, Navigation
Flight Management System Description**Chapter 11**
Section 30**Introduction**

The flight management system (FMS) aids the flight crew with navigation, in-flight performance optimization, automatic fuel monitoring, and flight deck displays. Automatic flight functions manage the airplane lateral flight path (LNAV) and vertical flight path (VNAV). The displays include a map for airplane orientation and command markers on the airspeed, altitude, and thrust indicators to help in flying efficient profiles.

The flight crew enters the applicable route and flight data into the CDUs. The FMS then uses the navigation database, airplane position, and supporting system data to calculate commands for manual and automatic flight path control.

The FMS tunes the navigation radios and sets courses. The FMS navigation database supplies the necessary data to fly routes, SIDs, STARs, holding patterns, and procedure turns. Cruise altitudes and crossing altitude restrictions are used to calculate VNAV commands. Lateral offsets from the programmed route can be calculated and commanded.

Flight Management Computer (FMC)

The basis of the flight management system is the flight management computer function. Since the term FMC is universally understood, it is used here for standardization and simplification.

Under normal conditions, one FMC accomplishes the flight management tasks while the other FMC monitors. The second FMC is ready to replace the first FMC if system faults occur.

The FMC uses flight crew-entered flight plan data, airplane systems data, and data from the FMC navigation database to calculate airplane present position and pitch, roll, and thrust commands necessary to fly an optimum flight profile. The FMC sends these commands to the autothrottle, autopilot, and flight director. Map and route data are sent to the NDs. The EFIS control panels select the necessary data for the ND. The mode control panel selects the autothrottle, autopilot, and flight director operating modes. Refer to the following chapters for operation of these other systems:

- Chapter 4, Automatic Flight
- Chapter 10, Flight Instruments, Displays.

The FMC is certified for area navigation when used with navigation radio and/or GPS updating. The FMC and CDU are used for enroute and terminal area navigation, RNAV approaches, and to supplement primary navigation during all types of instrument approaches.

Control Display Units (CDUs)

The flight crew controls the FMC using three CDUs. The CDUs give alternate display, communications control, and navigation capability if there is a dual FMC failure (refer to the Alternate Navigation section of this chapter). The center CDU is a backup for the left or right CDU in case of a failure and automatically takes over functionality of the failed CDU. Only the left and right CDUs tune navigation radios when alternate navigation is active.

Left and right CDUs provide backup to the left and right EFIS control panels, while the center CDU provides EFIS control panel backup for a failed left or right CDU. If the EFIS control panel or the display select panel fails, a manual selection of the CDU backup mode can be made on the MENU page.

Refer to Chapter 10, Flight Instruments, Displays for a description of alternate display control. Refer to Chapter 5, Communications, for a description of communications control.

Flight Management, Navigation
Flight Management System Operation**Chapter 11**
Section 31**Introduction**

When first powered, the FMS is in the preflight phase. When completing a phase, the FMS changes to the next phase in this order:

- preflight
- takeoff
- climb
- cruise
- descent
- approach
- flight complete

Preflight

During preflight, the flight crew enters the flight plan and load sheet data into the CDU. Some data can be entered by data link. The flight plan defines the route of flight from the origin to the destination and initializes LNAV. Flight plan and load sheet data provide performance data to initialize VNAV.

Required preflight data consists of:

- initial position
- route of flight
- performance data
- takeoff data

Optional preflight data includes:

- navigation database selection
- route 2
- alternate airport
- standard instrument departure (SID)
- standard terminal arrival route (STAR)
- thrust limits
- wind

Preflight starts with the IDENT page. If the IDENT page is not displayed, it can be selected with the IDENT prompt on the INIT/REF INDEX page. Visual prompts help the flight crew select CDU preflight pages. Preflight pages can be manually selected in any order.

After data on each preflight page is entered and checked, pushing the lower right line select key selects the next preflight page. After selecting ACTIVATE on the ROUTE page, the execute (EXEC) light illuminates. Pushing the EXEC key activates the route.

The departure/arrival (DEP/ARR) page can be used to select a SID. Selection of the SID may cause a route discontinuity. Resolution of the discontinuity and execution of the modification should be accomplished on the ROUTE or LEGS page.

When all required preflight entries are complete, the PRE–FLT line title on the TAKEOFF REF page is replaced by dashes and the THRUST LIM prompt displays at the next page select line location.

Takeoff

The takeoff phase starts with selection of TO/GA and terminates with thrust reduction for climb. LNAV and VNAV can be armed before takeoff to activate at the applicable altitude (refer to Chapter 4, Automatic Flight).

Climb

The climb phase starts at thrust reduction for climb and terminates at the top of climb (T/C) point. The T/C is where the airplane reaches the cruise altitude entered on the PERF INIT page.

Cruise

The cruise phase starts at the T/C point and terminates at the top of descent (T/D) point. Cruise can include step climbs and en route descents.

Descent

The descent phase starts at the T/D point or when the VNAV descent page becomes active, and terminates at the start of the approach phase.

Approach

The approach phase starts when the first waypoint of the procedure sequences or when the runway is the active waypoint and the distance to go is less than 25 nm.

Flight Complete

Thirty seconds after engine shutdown, the flight complete phase clears the active flight plan and load data. Some preflight data fields initialize to default values in preparation for the next flight.

Operational Notes

When operating in the LNAV and VNAV modes, observe system operation for unwanted pitch, roll, or thrust commands. If unwanted operation is observed, select heading select and flight level change modes.

The system must be carefully monitored for errors following:

- activation of a new data base
- power interruption
- ADIRU failure

The FMC will not sequence the active waypoint when more than 21 nm off the active route and not on an offset route. Return to the active route can be accomplished using the DIRECT TO or INTERCEPT COURSE TO/FROM procedures.

When a waypoint is in the route more than once, certain route modifications (such as DIRECT TO and HOLD) use the first waypoint in the route.

Some SIDs or STARS contain a heading vectors leg. VECTORS waypoints display on the ND as a magenta line without an end point leading away from the airplane symbol. If LNAV is active, the DIRECT TO or INTERCEPT COURSE TO/FROM procedures can be used to start waypoint sequencing beyond the vectors leg.

When entering airways in a route page, the start and end waypoints must be in the data base. A route segment must be entered as a DIRECT leg.

If the engines remain operating between flights, entering a new cruise altitude before the next flight recalculates the proper vertical profile.

If a climb to cruise altitude is necessary after completing a descent, a new cruise altitude entry must be made. Cruise altitude can be entered on the CLB page.

DIRECT TO courses are segments of a great circle route. When entering a DIRECT TO waypoint on the LEGS page, the course above the waypoint before execution is the arrival course at the waypoint. However, after execution, the course is the current course to fly to the waypoint. These courses may not be the same.

Terminology

The following paragraphs describe FMC and CDU terminology.

Active – flight plan data used to calculate LNAV or VNAV guidance commands.

Activate – changing a route from inactive to active for navigation by:

- selecting the ACTIVATE prompt
- pushing the execute (EXEC) key

Altitude constraint – a crossing restriction at a waypoint.

Delete – using the DELETE key removes FMC data and reverts to default values, dash or box prompts, or a blank entry.

Econ – a speed schedule calculated to minimize operating cost. The economy speed is based on the cost index. A low cost index causes a lower cruise speed. Maximum range cruise or the minimum fuel speed schedule may be obtained by entering a cost index of zero. This speed schedule ignores the cost of time. A minimum time speed schedule may be obtained by entering a cost index of 9999. This speed schedule calls for maximum flight envelope speeds. A low cost index may be used when fuel costs are high compared to operating costs.

Enter – putting data in the CDU scratchpad and line selecting the data to the applicable location. New characters can be typed or existing data can be line selected to the scratchpad for entry.

Erase – removing entered data, which has resulted in a modification, by selecting the ERASE prompt.

Execute – pushing the illuminated EXEC key to make modified data active.

Inactive – data not being used to calculate LNAV or VNAV commands.

Initialize – entering data required to make the system operational.

Message – FMC information displayed in the scratchpad.

Modify – changing active data. When a modification is made to the active route or performance mode, MOD displays in the page title, ERASE displays next to line select key 6 left, and the execute key illuminates.

Prompt – CDU symbols that aid the flight crew in accomplishing a task. Prompts can be boxes, dashes, or a caret (< or >) line to remind the flight crew to enter or validate data.

Purge – select the PURGE prompt to remove all airports uplinked to the ALTN LIST.

Select – pushing a key to obtain the necessary data or action, or to copy selected data to the scratchpad.

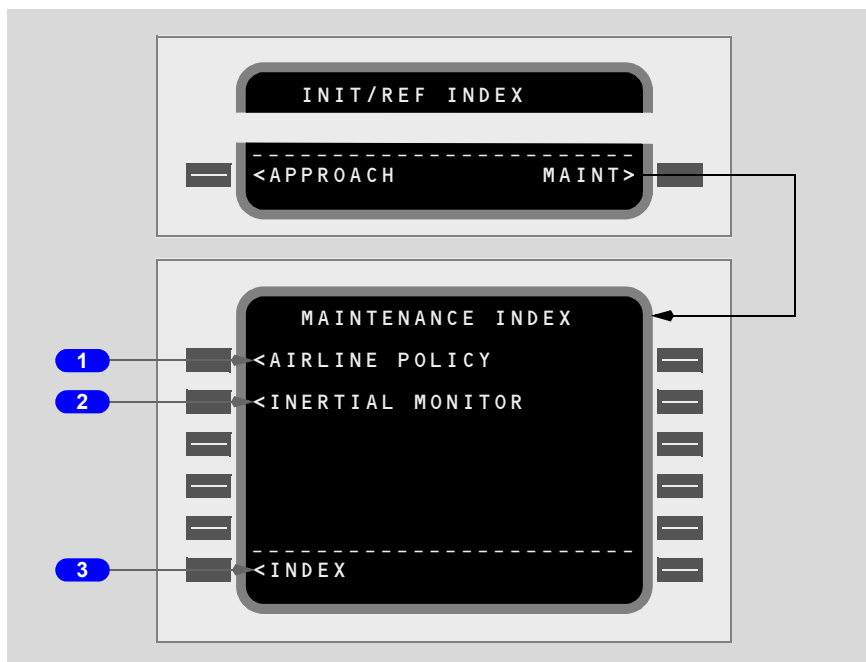
Speed restriction – an airspeed limit associated with a specified altitude entered by the flight crew.

Speed transition – an airspeed limit associated with a specified altitude entered by the FMC.

Waypoint – a point on the route or in the navigation database. It can be a fixed point such as a latitude and longitude, VOR or ADF station, or an airway intersection. A conditional waypoint is not associated with a land reference; it is based on a time or altitude requirement. An example of a conditional waypoint is “when reaching 4,000 feet”.

Maintenance Index

The MAINTENANCE INDEX page prompts are used only on the ground.



1 AIRLINE POLICY

The airline policy pages display operating parameters kept in the airline maintained file. The FMC references this file for data before it calculates default values. These pages are not usually used by the flight crew.

Push – displays the AIRLINE POLICY 1/2 page.

2 INERTIAL MONITOR

This is a maintenance function.

3 INDEX

Push – displays the INIT/REF INDEX page.

Navigation Position

The FMC position is determined from GPS, navigation radio, and ADIRS systems. When receiving reliable GPS data, the FMC position is from a GPS updated FMC position. If GPS data is not available, cannot be validated, or is inhibited, the FMC position is updated using navigation radios, when enabled. Further, if navigation radios are not available or not reliable, the FMC position is the inertial (ADIRU) position.

FMC Position Update

FMC position may be manually updated to any of the navigation system positions. This update is accomplished on POS REF page 2.

On the ground, the FMC calculates present position based on ADIRU and/or the GPS data.

If GPS updating is not available due to loss of signals, pushing a TO/GA switch updates the FMC position to the runway threshold or to the position shift position, when entered. When making an intersection takeoff, the intersection displacement distance from the runway threshold must be entered on the TAKEOFF REF page. With GPS NAV ON, the TO/GA update is inhibited.

In flight, the FMC position is continually updated from the GPS, navigation radios, and ADIRU. Updating priority is based on the availability of valid data from the supporting systems.

The FMC automatically tunes VOR, DME, and ILS radios for position updating and displays them on the ND and NAV RADIO page. Selection is related to the active route and any procedure (SID, STAR, etc.) in the active route. Manually selecting VOR frequencies or identifiers precludes the FMC from autotuning other VOR/DME frequencies for position updating; however, the FMC continues to tune DME-DME pairs for position updating.

FMC position updating using ADIRU and navigation sensor positions occurs in the following priority order:

- ADIRU and GPS
- ADIRU and LOC and DME-DME (NAV RAD INHIBIT - OFF)
- ADIRU and LOC and collocated VOR/DME (NAV RAD INHIBIT - OFF)
- ADIRU and LOC
- ADIRU and DME-DME
- ADIRU and a collocated VOR/DME
- ADIRU

The selected station identifiers of the radio navigation aids display on the POS REF page 2.

Primary FMC Position Update Source	POS REF page 2/3	ND Annunciation
GPS	GPS	GPS
LOC, DME DME valid; GPS invalid*	LOC–RADIO	LOC–DME–DME
LOC, VOR DME valid; GPS invalid*	LOC–RADIO	LOC–VOR–DME
LOC valid; GPS, DME, VOR invalid*	LOC	LOC
DME valid; GPS invalid	RADIO	DME–DME
VOR DME valid; GPS invalid	RADIO	VOR–DME
GPS, VOR, DME invalid	INERTIAL	INERTIAL
GPS valid, ADIRU failed	GPS	GPS
GPS invalid; ADIRU failed	blank	map not available
Localizer updating is inhibited when GPS/INERTIAL is the navigation update mode. * The FMC changes to LOC updating when: • the tuned localizer is associated with the destination runway • the airplane is less than 6,000 feet above localizer navaid elevation • the airplane is less than 20 nm from the localizer navaid for a front course approach or less than 12 nm for a back course approach • the airplane is within a 25° sector of the inbound localizer course • the difference between airplane track and the localizer course is less than a 45° intercept angle		

FMC Polar Operations

When entering the polar region, automatic switching to a true north reference is annunciated by a white box around the word TRU on the ND. A TRUE heading reference can be selected with the heading reference switch inside or outside the polar region. The ND displays a green box around the word MAG to annunciate the change back to magnetic reference when leaving the polar region. If the heading reference is TRU in the descent phase, the ND displays a flashing amber box around the word TRU.

[Option - Grid Heading Display]

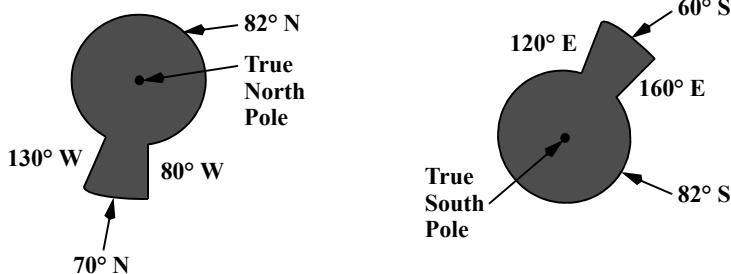
The current GRID heading displays near the top of both NDs when the airplane is north of 70°N or south of 70°S. The GRID heading is not used by any airplane system.

Note: When operating the autopilot in the polar region in other than LNAV, the TRUE position on the heading reference switch must be selected.

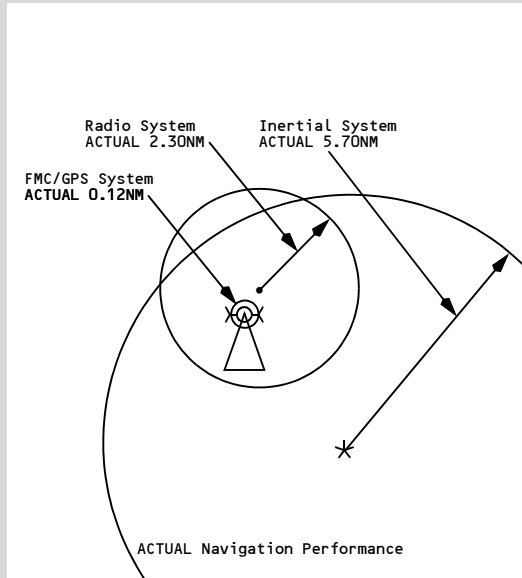
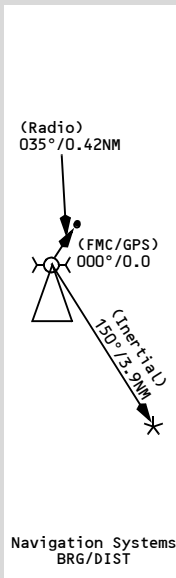
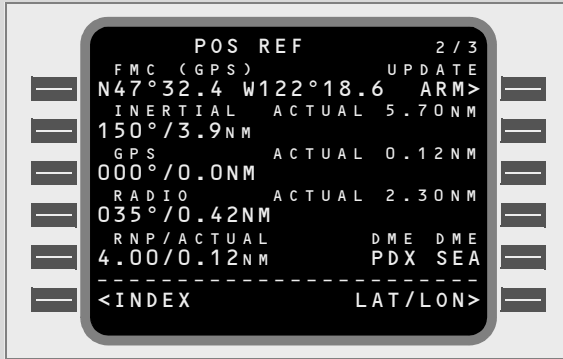
Note: When operating north of 82°N or south of 82°S using the ND PLAN mode, the airplane position symbol does not display.

Note: If the ADIRU fails in a polar region, the EICAS message NAV ADIRU INERTIAL displays and all autopilot and AFDS roll modes fail. When heading information is restored by entry of a reference heading on the POS INIT page, HDG SEL and HDG HOLD roll modes are restored. GPS continues to provide navigation data to the FMC and active route information displays on the ND. When operating in this degraded mode, heading on the POS INIT page may be referenced to magnetic, true, or grid heading. The heading display drifts significantly under these conditions. Periodic updating of the heading reference on the POS INIT page should be accomplished at least every 10 minutes.

FMC Polar Regions



Navigation Performance



The FMC uses data from the navigation systems to accurately calculate the position of the airplane. The current FMC position displays on line 1 of the POS REF page 2. The primary source of update displays in parentheses above the FMC position.

Navigation system positions display on the left side of lines 2 through 4. The bearing/distance is from the FMC position to the individual navigation system position.

The FMC position displays on the ND at the tip of the triangle. All other positions display relative to the FMC. The RADIO position is shown above as a •, but is not shown on the ND. The ACTUAL navigation performance circles shown above do not display on the ND.

Actual Navigation Performance

Actual navigation performance (ANP) is the FMC current computed position accuracy. It is titled ACTUAL and displays on the POS REF page 2 for the navigation system displayed in title line 1. ACTUAL navigation performance is a circular prediction centered at the FMC position. Airplane position is estimated to be within this ACTUAL navigation performance circle 95 percent of the time.

After a manual position update, the ACTUAL navigation performance of the FMC changes to the ACTUAL navigation performance of the selected navigation system. In the example above, a manual position update to the INERTIAL system would change the FMC ACTUAL navigation performance to 5.7 NM. The FMC then updates from the best available navigation system and eventually, the manual update has no effect on position calculation. Some automatic updates can be inhibited; GPS on POS REF page 3 and VOR/DME updates on the REF NAV DATA page. Inertial and DME/DME updates can not be inhibited.

Required Navigation Performance

Required Navigation Performance (RNP) is the navigation accuracy required for operation within a defined airspace. It is expressed in nautical miles. RNP values have been published for areas of operation around the world. Operations in these areas require on-board navigation systems to alert the flight crew if ANP exceeds RNP. The FMC supplies a default RNP value for takeoff, en route, oceanic/remote, terminal, and approach phases of flight. The flight crew may enter an RNP value, if required. RNP displays on POS REF page 2.

Lateral Navigation (LNAV)

LNAV provides steering commands to the next waypoint or the selected route intercept point. When armed on takeoff, LNAV engages at or above 50 feet, when laterally within 2.5 nautical miles of the active route leg. FMC LNAV guidance normally provides great circle courses between waypoints. However, when an arrival or approach from the FMC data base is entered into the active route, the FMC commands a heading, track, or a DME arc to comply with the procedure.

Waypoints

Waypoint (navigation fix) identifiers display on the CDU and navigation display.

The CDU message NOT IN DATABASE displays if a manually entered waypoint identifier is not kept in the data base. The waypoint can still be entered as a latitude/longitude, place-bearing/distance or place-bearing/place-bearing waypoint.

FMC-generated waypoints contain a maximum of five characters assigned according to the following rules:

Navaid Waypoints

VHF – waypoints located at VHF nav aids (VOR/DME/LOC) are identified by one, two, three or four character facility identifier. Examples:

- Los Angeles VORTAC – LAX
- Tyndall TACAN – PAM
- Riga Engure, USSR – AN

NDB – waypoints located at NDBs are identified by use of the station identifier. Example: FORT NELSON, CAN – YE.

Fix Waypoints

Waypoints located at fixes with names containing five or fewer characters are identified by the name. Examples:

- DOT
- ACRA
- ALPHA

Long Waypoints

Waypoints with more than five characters are abbreviated using the following rules sequentially until five characters remain. For double letters, one letter is deleted. Example:

- KIMMEL becomes KIMEL

Keep the first letter, first vowel and last letter. Delete other vowels starting from right to left. Example:

- BAILEY becomes BAILY

The next rule abbreviates names even further. Apply the previous rule, then delete consonants from right to left. Example:

- BRIDGEPORT becomes BRIDGPRT then BRIDT

Fixes with multiword names use the first letter of the first word and abbreviate the last word, using the above rules sequentially until a total of five characters remain. Examples:

- CLEAR LAKE becomes CLAKE
- ROUGH ROAD becomes RROAD

Unnamed Waypoints

If an unnamed turn point, intersection, or fix is collocated with a named waypoint or navaid on a different route structure (such as low altitude routes or an approach), the name or identifier of the collocated waypoint is used. Example:

- Unnamed turn point on J2 between the Lake Charles (LCH) and New Orleans (MSY) VORTACs is coincidental with the Lafayette (LFT) low altitude VORTAC. LFT is used as the identifier for the turn point

Identifier codes for unnamed turn points not coincidental with named waypoints are constructed from the identifier of a navaid serving the point and the distance from the navaid to the point. If the distance is 99 nautical miles or less, the navaid identifier is placed first, followed by the distance. If the distance is 100 nautical miles or more, the last two digits are used and placed ahead of the navaid identifier. Examples (NAVAID – DISTANCE – IDENT):

- INW – 18 – INW18
- CSN – 106 – 06CSN

Waypoint located at unnamed flight information region (FIR), upper flight information region (UIR), and controlled airspace reporting points are identified by the three-letter airspace type identification followed by a two-digit sequence number. Example:

- FRA01

Unnamed oceanic control area reporting points in the northern hemisphere use the letters N and E, while points in the southern hemisphere use the letters S and W. Latitude always precedes longitude. For longitude, only the last two digits of the three digit value are used.

Placement of the designator in the five character set indicates whether the first longitude digit is 0 or 1. The letter is the last character if the longitude is less than 100° and is the third character if the longitude is 100° or greater.

N is used for north latitude, west longitude. E is used for north latitude, east longitude. S is used for south latitude, east longitude. W is used for south latitude, west longitude. Examples:

- | | |
|----------------------------|----------------------------|
| • N50° W040° becomes 5040N | • S52° W075° becomes 5275W |
| • N75° W170° becomes 75N70 | • S07° W120° becomes 07W20 |
| • N50° E020° becomes 5020E | • S50° E020° becomes 5020S |
| • N06° E110° becomes 06E10 | • S06° E110° becomes 06S10 |

Procedure Arc Fix Waypoint Names

Unnamed terminal area fixes along a DME arc procedure are identified with the first character D. Characters 2 through 4 indicate the radial on which the fix lies. The last character indicates the arc radius. The radius is expressed by a letter of the alphabet where A = 1 mile, B = 2 miles, C = 3 miles and so forth. Example:

- EPH252°/24 = D252X

An unnamed waypoint along a DME arc with a radius greater than 26 miles is identified by the station identifier and the DME radius. Example:

- CPR338°/29 = CPR29

When there are multiple unnamed waypoints along a DME arc with a radius greater than 26 miles, the station identifier is reduced to two characters, followed by the radius, and then a sequence character. Examples:

- CPR134°/29 = CP29A
- CPR190° /29 = CP29B

Procedure Fix Waypoints

Marker beacons are identified by the marker type identifier followed by the runway number. Examples:

- Outer Marker 13R = OM13R
- Middle Marker 21 = MM21

Runway-related fixes – waypoints located at unnamed runway-related fixes are identified by adding a two-letter prefix to the runway number. The following list is used to determine the applicable prefix:

- | | |
|--|---|
| <ul style="list-style-type: none"> • RX – runway extension fix • FA – VFR final approach fix • CF – final approach course fix • FF – final approach fix • IF – initial approach fix • OM – outer marker • MM – middle marker • IM – inner marker | <ul style="list-style-type: none"> • BM – back course marker • MD – minimum descent altitude • A – (+ an alpha) step down fix • RW – runway threshold • MA – missed approach point other than RW • TD – touchdown point inboard of RW |
|--|---|

Examples: OM25L, MM09, IM23, RW04, RW18L.

For airports with more than one approach to the same runway, the two letter prefix may change to allow different identifiers for the same waypoint. The first letter identifies the type of fix and the second letter identifies the type approach as follows:

- | | |
|---|---|
| <ul style="list-style-type: none"> • C() – final approach course fix • F() – final approach fix • P() – missed approach point • I() – initial approach fix • D() – minimum descent altitude • T() – touch down point • R() – runway centerline intercept. • ()I – ILS | <ul style="list-style-type: none"> • ()L – localizer only()B –backcourse ILS • ()D – VOR/DME • ()V – VOR only • ()S – VOR with DME points • ()N – NDB • ()Q – NDB with DME points • ()M – MLS • ()T – Tacan • ()R – RNAV |
|---|---|

Examples: CI32R, PV15, FN24L.

Unnamed turn points that are part of a procedure are identified as a latitude and longitude waypoint. These include waypoints (except conditional waypoints) defined by flying a course or track from a waypoint (except conditional waypoints) to a radial or DME distance. These waypoints are automatically entered in a route by selection of a procedure using these waypoints, from the departures or arrivals page.

Airport reference points are identified by the ICAO identifier.

DME step down fixes are identified by the distance and a “D”.

Examples: 138D, 106D, 56D, 3D.

Duplicate Waypoints

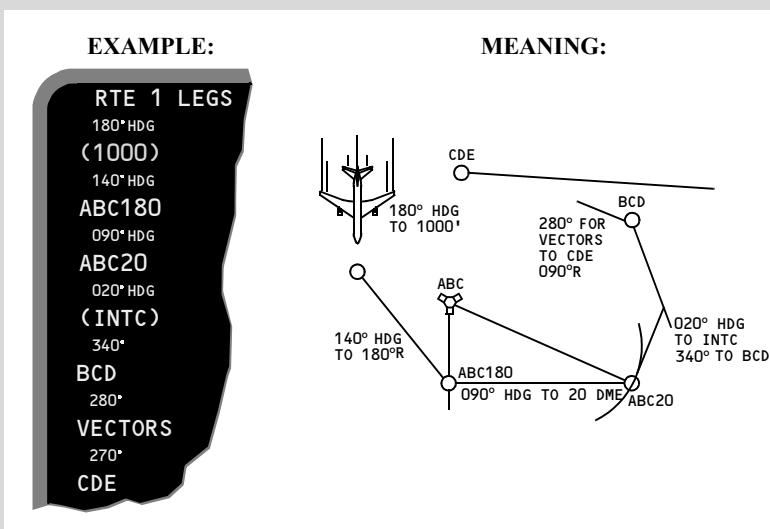
Application of the abbreviation rules may create identical identifiers for different waypoints. When a duplicate waypoint identifier is entered, the page changes to the SELECT DESIRED WPT page. The page lists the latitude and longitude of waypoints with the same identifier and the type of facility or waypoint. Select the latitude/longitude of the correct waypoint to enter the correct waypoint on the original page.

Conditional Waypoints

Conditional waypoints may display in the route when selecting a DEPARTURES or ARRIVALS page procedure. Usually, conditional waypoints cannot be manually entered on a route or legs page. These waypoints indicate when an event occurs and are not at a geographically-fixed position. The types of conditions are:

- climb/descent through an altitude
- intercepting a course
- flying a heading to a radial or DME distance
- heading vectors to a course or fix

Altitude and course intercept conditional waypoints display on the CDU inside (parenthesis) marks. The diagram below shows conditional waypoints.



Note: All waypoints except BCD and CDE are examples of conditional waypoints.

Manually Entered Latitude/ Longitude Waypoints

Pilot defined waypoints entered as a latitude and longitude display in a seven-character format. Latitude and longitude waypoints are entered with no space or slash between the latitude and longitude entries. Leading zeroes must be entered. All digits and decimal points (to 1/10 minute) must be entered unless the latitude or longitude are full degrees. Examples:

- N47° W008° is entered as N47W008 and displays as N47W008
- N47° 15.4' W008° 3.4' is entered as N4715.4W00803.4 and displays as N47W008

Manually Entered Place Bearing/Distance or Place Bearing/Place Bearing Waypoints

Waypoints entered as a place bearing/distance or place bearing/place bearing are identified by the first three characters of the entry followed by a two-digit sequence number. Examples:

- SEA330/10 becomes SEA01
- SEA330/OLM020 becomes SEA02

The two digit sequence numbers reserved for RTE1 are 01 through 49. The two digit sequence numbers reserved for RTE2 are 51 through 99.

Manually Entered Airway Crossing Waypoints

Airway crossing fixes are entered as a five character waypoint name or by entering consecutive airways on the ROUTE page. In the latter case, the display is an X followed by the second airway name. Example: entering J70 on the VIA line of the ROUTE page causes box prompts to display opposite on the same line. Leaving the box prompts empty and entering J52 on the next VIA line, directly below J70, causes the FMC to calculate the intersection of the two airways and replace the boxes with the waypoint identifier, XJ52.

Manually Entered Latitude or Longitude Reporting Point Waypoints

Latitude or longitude reporting waypoints are entered as the full latitude or longitude followed by a dash, then the increment chosen for the following multiple waypoints. Example:

- W060–10 adds waypoints starting at W060 in ten degree increments from that point to the destination
- the entry must be made on a LEGS page on any line before the first reporting point
- usually, this entry is made on the active waypoint line and proper sequencing is performed by the FMC

Manually Entered Along–Track Waypoints

Along–track waypoints are created on the active route and do not cause route discontinuities when they are created.

Along–track waypoints are entered using the waypoint name (the place), followed by a slash and minus sign, for points before the waypoint, or no sign for points after the waypoint, followed by the mileage offset for the newly defined waypoint. The created waypoint is then inserted over the original waypoint. The distance offset must be less than the distance between the originating waypoint and next (positive value) or preceding (negative value) waypoint. Latitude and longitude waypoints cannot be used to create along–track waypoints. Examples:

- VAMPS/25 is 25 miles after VAMPS on the present route and displays as VAM01
- ELN/-30 is 30 miles before ELN on the present route and displays as ELN01

ND Map Displays

The route displays on the ND in the map, map center, and plan modes. The display color and format represent the following status:

- an inactive route displays as a cyan dashed line
- an activated, but not yet executed route, displays as an alternating cyan/white dashed line
- the active route displays in magenta

- modifications to an active route display as dashed white lines
- modified waypoints display in white
- executed route offsets display as a dashed magenta line

The ND displays the FMC position at the apex of the airplane symbol. All ND map data displays relative to this apex.

When adequate GPS or radio updating is not available, the ND map may display a shift error. This error results in the displayed position of the airplane, route, waypoints, and navigation aids being shifted from their actual position. An undetected, across track map shift may result in the airplane flying a ground track that is offset from the desired track. An undetected, along track map shift may result in the flight crew initiating altitude changes earlier or later than desired. In either case, an undetected map shift may compromise terrain or traffic separation.

Map shift errors can be detected by comparing the position of the airplane on the ND map with data from the ILS, VOR, DME, and ADF systems.

Vertical Navigation (VNAV)

VNAV provides vertical profile guidance through the climb, cruise, and descent phases of flight. Three VNAV CDU pages correspond to these flight phases. Pressing the VNAV function key displays the active phase page. Other VNAV pages display using the next or previous keys.

Vertical Actual Navigation Performance (VANP)

Vertical Actual Navigation Performance is the FMC estimate of the quality of altitude determination. It displays on the RNP PROGRESS page. VANP is the estimated maximum altitude error. The FMC computes the vertical path and the certainty the actual altitude is within a vertical range equal to plus or minus the displayed VANP value.

Note: VANP is calculated from the baro-corrected altitude provided by the Air Data System. The pilot must set the baro setting reported by ATIS or by the setting given in the approach clearance for the display to be valid.

Speed/Altitude Constraints

VNAV controls the path and speed to comply with waypoint crossing constraints. Waypoint crossing constraints are entered on the LEGS page waypoint line by pushing the applicable key on the right side of the CDU. Barometric altitude constraints must be below the cruise altitude to be valid. Values entered as part of a procedure and manually entered constraints are shown in large font. FMC predicted values do not act as constraints, and display in small font.

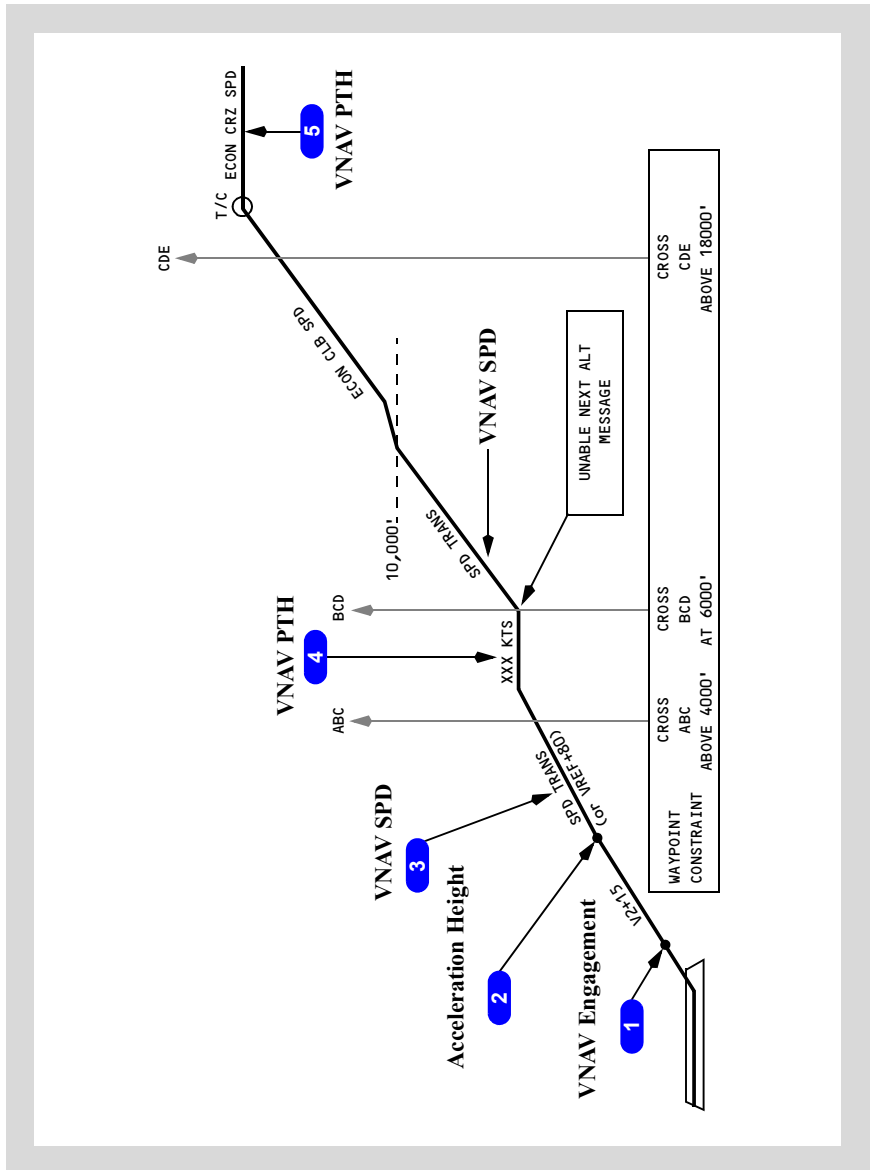
A waypoint constraint is magenta when it is active. The constraint does not have to be in line 1 to be active. Waypoints can have altitude or airspeed/altitude constraints.

Modified waypoint constraints are shaded white until they are executed. Speed constraint entries require an altitude constraint at the same waypoint. All speed constraints are considered by the FMC as at or below constraints.

At or above altitude constraints are entered with a suffix letter A (example: 220A). At or below altitude constraints are entered with a suffix letter B (example: 240B). Mandatory altitude constraints are entered without any suffix letter (example: 270).

Altitude constraints with two altitudes may be entered in either order. The lower altitude constraint, followed by a suffix letter A, and the upper altitude constraint, followed by a suffix letter B (example: 220A240B or 240B220A).

Takeoff and Climb



1 Takeoff

If armed for takeoff, VNAV activates at 400 feet and pitch guidance continues to maintain the target airspeed.

During takeoff, the FMC updates the target airspeed to the current airspeed until VNAV activates. The target airspeed is between $V_2 + 15$ and $V_2 + 25$ knots.

2 Acceleration Height

At acceleration height or flap retraction, VNAV commands an airspeed increase to a speed 5 knots below the flap placard speed for the existing flap setting. When flaps are retracted or at an AFDS capture altitude, VNAV commands the greater of $V_{REF} + 80$ knots or the speed transition associated with the origin airport, limited by configuration.

The FMC changes the thrust reference mode to the selected climb thrust at the thrust reduction point.

3 VNAV Climb

VNAV climb profile uses VNAV SPD or VNAV PTH at the default climb speed or pilot selected climb speed to remain within all airspeed and altitude constraints of an active route Standard Instrument Departure. Autothrottle uses the armed climb thrust limit.

If the climb speed profile cannot achieve an altitude constraint, the UNABLE NEXT ALT scratchpad message displays.

4 Climb Constraints

VNAV enters the VNAV PTH mode to remain within departure or waypoint constraints. Speed maintained during this time can be:

- procedure based speed restriction
- waypoint speed restriction
- default VNAV climb speed
- manually entered climb speed

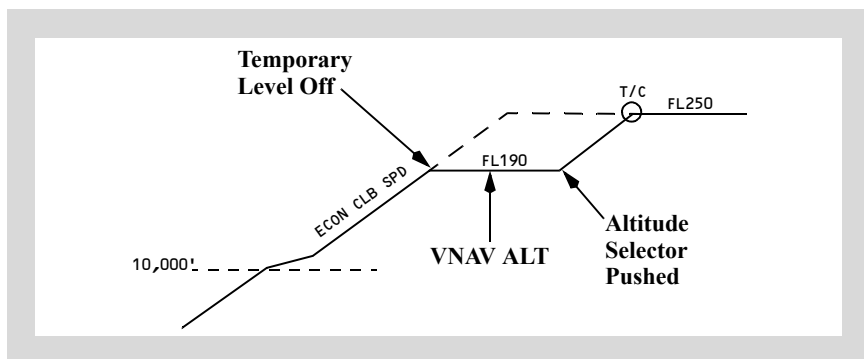
If the FMC predicts the airplane will not reach an altitude constraint, the FMS-CDU message UNABLE NEXT ALTITUDE displays. Speed intervention can be used by pushing the IAS/MACH selector and manually setting a lower airspeed to provide a steeper climb; or, climb derates can be deleted on the THRUST LIMIT page.

5 Top Of Climb (T/C)

The point where the climb phase meets the cruise altitude is called the top of climb. Approaching this point, the FMC changes from the climb phase to the cruise phase. The T/C displays any time the FMC calculates a change from a climb phase to a cruise phase, such as a step climb.

The T/C point displays on the map as a green open circle with the label T/C.

MCP Altitude Intervention



Whenever the airplane levels off at an MCP altitude not in the FMC, VNAV ALT annunciates. For example, FMC cruise altitude is FL250 and the clearance altitude, FL190, is set in the MCP. Pitch maintains altitude and thrust maintains FMC target speed. In the example, the speed after the temporary level off would be ECON CLB SPEED.

Setting the clearance altitude in the MCP window and pushing the altitude selector continues the climb. VNAV SPD activates. Pitch maintains FMC speed and thrust increases to the armed reference thrust limit. In the example, the airplane climbs to FMC CRZ ALT and then levels at FL250 in cruise.

Cruise

During cruise, the FMC commands economy cruise speed or the pilot entered speed until reaching the top-of-descent (T/D) point. Other cruise speed options are:

- long range (LRC)
- engine out (ENG OUT)
- flight crew entered speed
- flight crew entered constant Mach between two or more waypoints
- required time of arrival (RTA)

The FMC commands maximum range cruise speed with the cost index set to zero. Cost index modifications are allowed until within ten miles of the top of descent.

Step Climb

Fuel and ETA predictions assume the airplane climbs at each predicted step climb point as airplane weight decreases. FMC predicted step climb increments are based on the step size shown on the CRZ page. Entering a step size of zero causes the FMC to assume a constant altitude cruise.

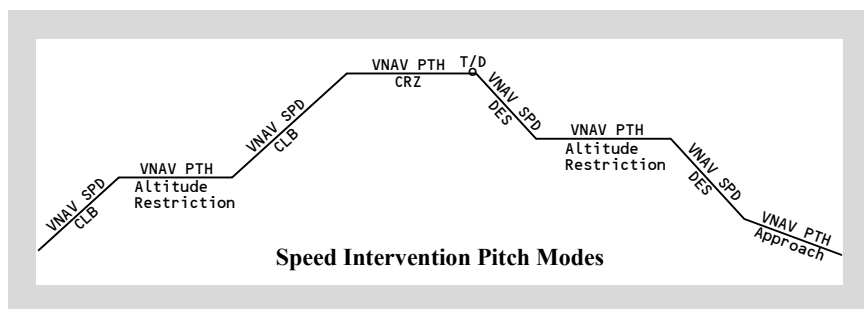
Flight crew entry of a step altitude on the CRZ or RTE LEGS page overrides the FMC step climb predictions. Entry of a planned step altitude on the RTE LEGS page overrides a “Step To” entry made on the CRZ page.

Predicted step altitudes display on the RTE LEGS page. The distance and ETA to the next step point (predicted or flight crew entered) display on the CRZ and Progress pages. They also display on the ND map display with a green circle and S/C label.

Cruise Descent

Setting an altitude below the current cruise altitude in the MCP altitude window and pushing the altitude selector (more than 50 nm from a T/D) causes the cruise altitude to be set to the MCP altitude and the airplane to descend to the new cruise altitude. The CRZ page displays ACT ECON CRZ DES. If the altitude set in the altitude window is below the speed transition (SPD TRANS) or restriction (SPD RESTR) altitude displayed on the DES page, those altitudes and speeds are deleted. Transition or speed restrictions must be maintained by flight crew action.

Mode Control Panel Speed Intervention



With VNAV active, pushing the IAS MACH selector enables speed intervention. Speed intervention allows the flight crew to change airplane speed with the IAS/MACH selector.

The above illustration shows the VNAV pitch flight mode annunciation for each phase of flight when using speed intervention.

In a VNAV descent after the T/D, VNAV PTH changes to VNAV SPD during speed intervention. In all other phases, the pitch mode does not change with speed intervention. Pitch controls speed in VNAV SPD mode, and during the VNAV PTH descent prior to speed intervention. Otherwise, thrust controls speed in VNAV PTH mode.

During a VNAV, non-ILS approach while using speed intervention, the pitch mode is VNAV PTH. The vertical path is maintained regardless of IAS MACH selector changes.

If a “direct to” is executed to a waypoint in the approach, VNAV transitions to the approach phase when the airplane passes the “direct to” waypoint. If a waypoint located after the first waypoint of an FMC database approach is added and executed, VNAV will not transition to approach phase when passing the first waypoint of the approach.

Descent

The FMC calculates a descent path based on airspeed and altitude constraints and the end of descent (E/D) point. Dashes display on the LEGS page for speed and altitude descent waypoints. When an arrival or approach procedure is selected on the ARRIVALS page and incorporated into the flight plan, the FMC creates an E/D. The E/D is located 50 feet above the runway threshold (RW waypoint) for all approaches except VOR approaches. The E/D for VOR approaches is the missed approach point; which may be the VOR, runway waypoint (RWXXX), or a named waypoint. During cruise, an E/D is also created when an altitude constraint is entered on the LEGS page on a downstream waypoint.

The top of descent (T/D) is the point where the cruise phase changes to the descent phase. A green circle T/D symbol displays on the ND at the start descent phase point. The FMC displays a T/D symbol at each point in the descent profile which represents a transition from a level segment to a descent segment. The descent path starts at the T/D and includes waypoint altitude constraints. The path to the first constraint is based on:

- idle thrust
- speedbrakes retracted
- FMC cruise wind
- wind entries on the DESCENT FORECAST page
- predicted use of anti-ice
- applicable target speed

The descent may be planned at economy Mach/CAS (based on Cost Index) or a manually entered Mach/CAS. VNAV will not command an economy target speed greater than 314 knots (VMO/MMO minus 16 knots) or a pilot entered speed greater than 319 knots (VMO/MMO minus 11 knots).

The FMC creates the descent path with a deceleration at the speed transition altitude (typically 250 knots below 10,000 feet). VNAV plans a speed target 10 knots below the transition speed to allow for unknown tailwinds.

Descent path segments after the first altitude constraint waypoint are constructed as straight line point-to-point segments. If the VNAV path segment is too shallow to be flown satisfactorily at IDLE thrust, the FMC commands speed on thrust levers (SPD). Elevators control the shallow descent path.

If flight plan modifications or unknown winds occur when above the first speed constraint, VNAV varies speed to maintain the path up to the following limits:

- with greater than 15 knots below the target speed, the autothrottle changes from IDLE/HOLD to SPD to provide thrust to accelerate to the target speed. If the autothrottle is not active, the scratchpad message THRUST REQUIRED displays. The airspeed may decrease to minimum maneuvering speed. Subsequently, VNAV commands the airplane to fly below the path to stop the deceleration. If VNAV can no longer maintain the airplane within 150 feet of the path without further deceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV resets the target speed to 5 knots above the greater of best holding speed or minimum maneuvering speed, and the scratchpad message THRUST REQUIRED displays again
- with greater than 314 knots (VMO/MMO minus 16 knots), the scratchpad message DRAG REQUIRED displays. The airplane may accelerate up to 319 knots (VMO/MMO minus 11 knots) to maintain the path. If further correction is required, VNAV may allow the airplane to rise up to 150 feet above the path. If VNAV can no longer maintain the airplane within 150 feet of the path without further acceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV resets the target speed to 314 knots (VMO/MMO minus 16 knots), and the scratchpad message DRAG REQUIRED displays again

If flight plan modifications or unknown winds occur when below the first speed constraint, VNAV varies speed to maintain the path up to the following limits:

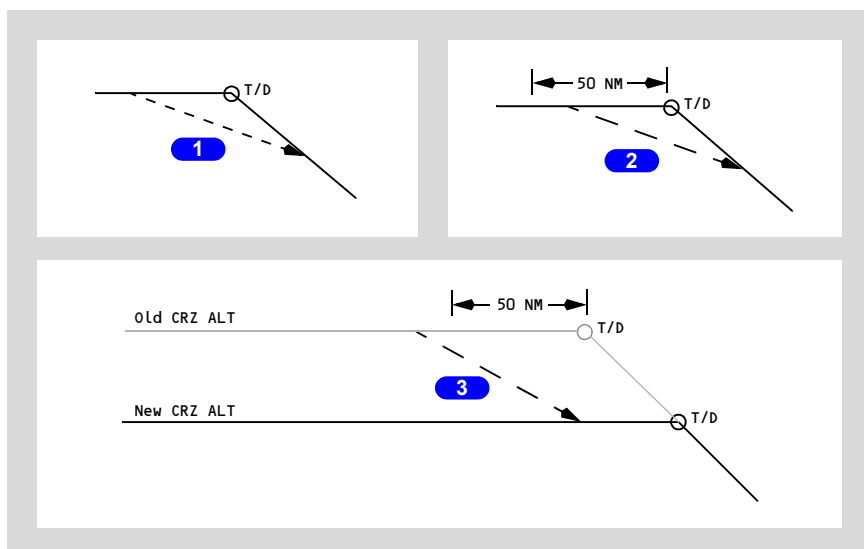
- with greater than 10 knots below the target speed, the autothrottle changes from IDLE/HOLD to SPD to provide thrust to accelerate to the target speed. If the autothrottle is not active, the scratchpad message THRUST REQUIRED displays. The airspeed may decrease to minimum maneuvering speed. Subsequently, VNAV commands the airplane to fly below the path to stop the deceleration. If VNAV can no longer maintain the airplane within 150 feet of the path without further deceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV commands a speed 10 knots less than the transition speed for the destination airport (not less than minimum maneuvering speed), and the scratchpad message THRUST REQUIRED displays again

- with greater than 10 knots above target speed, the scratchpad message DRAG REQUIRED displays. The airplane may accelerate up to 15 knots above target speed to maintain the path. The maximum speed excursion allowed is 5 knots above the transition speed after the airplane is below transition altitude for the destination airport or 5 knots below the flaps placard speed if flaps are extended. If further correction is required, VNAV may allow the airplane to rise up to 150 feet above the path to stop the acceleration. If VNAV can no longer maintain the airplane within 150 feet of the path without further acceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV commands a speed 10 knots less than the transition speed for the destination airport, and the scratchpad message DRAG REQUIRED displays again

Early Descent

When a descent is started before the T/D, VNAV commands a descent at a reduced descent rate until the idle descent path is intercepted.

Start an early descent by selecting the DES NOW prompt on the DES page or by pushing the MCP altitude selector. In an early descent, the autothrottle mode annunciation is initially THR, followed by HOLD, allowing the pilot to adjust the rate of descent. The pitch mode is VNAV SPD.



1 DES NOW

Use the DES NOW prompt on the VNAV DES page. VNAV starts an early descent and captures the idle descent path.

2 Within 50 NM of Top of Descent Point

Use the MCP altitude selector to start an early descent. Within 50 NM of the top of descent point, VNAV starts an early descent and captures the idle descent path.

3 More than 50 NM from Top of Descent Point

Use the MCP altitude selector to start a cruise descent. If the distance from the top of descent is more than 50 NM, VNAV begins a cruise descent to the new cruise altitude. VNAV may not capture the idle descent path since the target airspeed is economy cruise and the descent path is based on idle thrust and economy descent airspeed. In the example, VNAV levels at the new cruise altitude.

Approach

The FMC transitions to "on approach" mode for any of the following conditions:

- the descent phase is active and flaps are out of up, or
- the airplane has sequenced the first waypoint (or FXXXX) of the active approach, or
- the airplane is on a direct-to or intercept course-to the active waypoint and the distance to go is less than 12 NM, or
- the missed approach point is the active waypoint and the distance to go is less than 25 NM

The approach condition may be delayed if the flight crew manually inserts, bypasses, or deletes an approach waypoint on the LEGS page.

The FMC transitions out of "on approach" under the following conditions:

- the pilot selects TOGA
- the airplane lands
- the airplane flies beyond the last waypoint in the approach (missed approach waypoint or runway). The VNAV page title changes from "ACT xxxxx DES" to "ACT END OF DES"

When the FMC is "on approach", the following features are available:

- the IAS/MACH window can be opened and the command speed can be set while VNAV remains in VNAV PTH descent; VNAV commands the set speed
- the MCP altitude can be set above the airplane altitude for the missed approach. When the MCP altitude setting is at least 300 feet above the current airplane altitude, VNAV continues to command a descent

- VNAV remains in VNAV PTH and follows the descent path unless the airplane accelerates to within 5 knots of the current flap placard and the airplane rises more than 150 feet above the path. In this case, VNAV PTH changes to VNAV SPD
- When a glide path angle is specified for one or more legs on the approach, it displays on the LEGS page and VNAV provides VNAV PTH guidance at the displayed angle. When sequencing a waypoint prior to a descent leg specified by a glide path angle, VNAV commands level flight until the airplane intercepts the descent path

Note: Display of a specified glide path angle is not limited to approaches. A glide path angle may be defined for a leg in a STAR and displays on the LEGS page for the procedure.

Selection of another approach can be accomplished on the ARRIVALS page. An along-course intercept to the next logical approach waypoint in the new approach can be selected on the "INTC CRS TO" line on the LEGS page or by selecting the "XXXXX INTC>" prompt on the ARRIVALS page.

Missed Approach

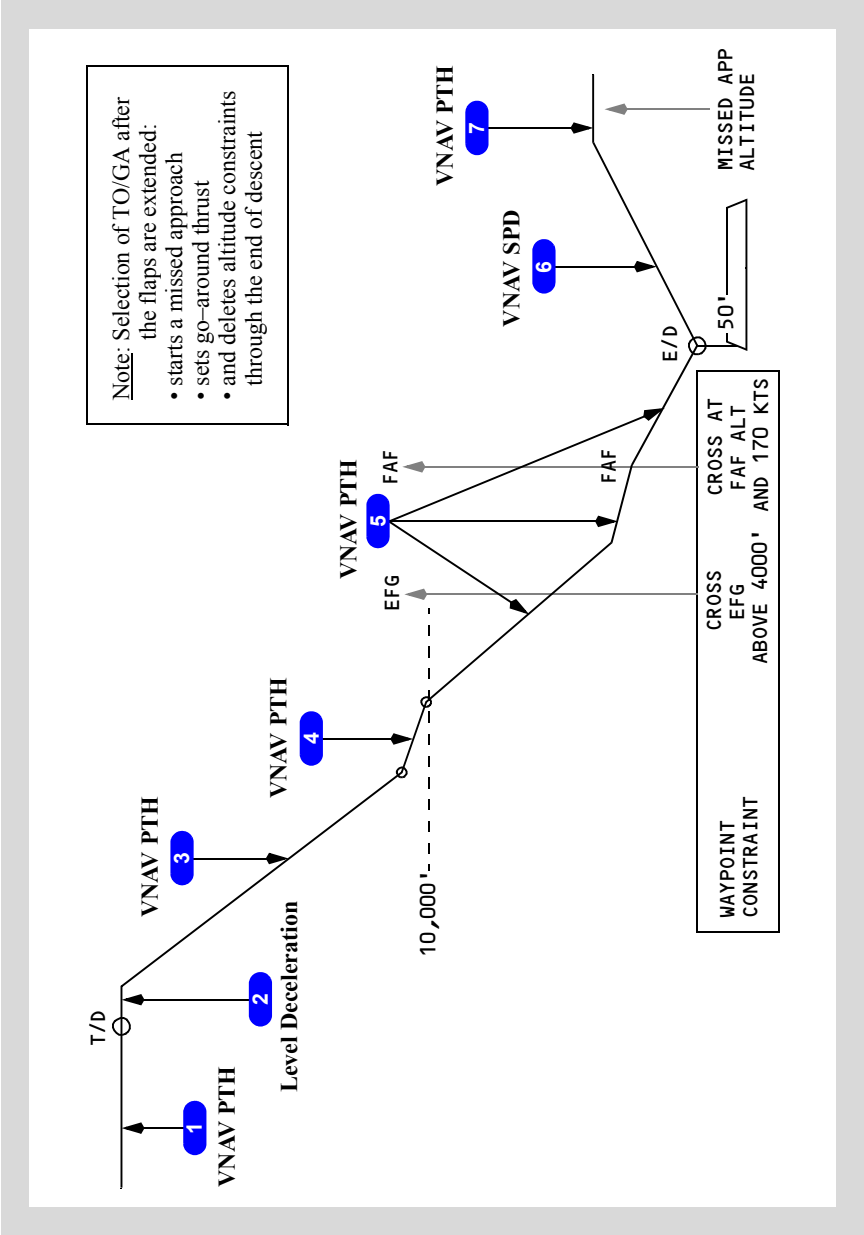
A missed approach is accomplished by selection of either TOGA switch. The following features are available:

- VNAV can only be activated when the airplane climbs above 400 feet radio altitude
- if an LNAV path is available, LNAV automatically arms and engages:
 - above 50 feet radio altitude when autopilot is not engaged, or
 - above 200 feet radio altitude when autopilot is engaged

Note: Route discontinuities after the missed approach will prevent the TO/GA to LNAV function from engaging.

- all descent altitude constraints below the current airplane altitude are deleted; the waypoints are retained in the active flight plan
- the highest altitude in the missed approach procedure becomes the new cruise altitude
- the FMC transitions from active descent to active climb. This transition also occurs when the airplane climbs toward the MCP altitude and flaps are retracted from a landing position (25 or 30 towards 20, or 20 towards 5). For example, when a missed approach is accomplished without pushing the TOGA switch.
- AFDS guidance to fly the published missed approach procedure to the new cruise altitude is active when VNAV (and LNAV) are selected
- when cruise phase is active, the speed target is the most restrictive of speed transition, best hold speed, or ECON cruise (above speed transition altitude)

Cruise and Descent Profile (Instrument Approach Using VNAV)



1 Cruise

Before the top of descent, FMC is in cruise mode and commands VNAV PTH and ECON cruise speed.

2 Level Deceleration Phase

At top of descent, FMC transitions to descent and commands the airspeed to ECON descent speed and maintains altitude in VNAV PTH.

3 Descent

Nearing descent speed, VNAV commands a descent in VNAV PTH at ECON descent speed.

4 Descent Deceleration Phase

Before the speed restriction altitude, the FMC commands the target descent airspeed. The pitch mode remains VNAV PTH and the descent rate approximates 500 feet per minute.

5 Descent and Approach

When at target speed, VNAV commands a descent and starts approach in VNAV PTH at commanded speed.

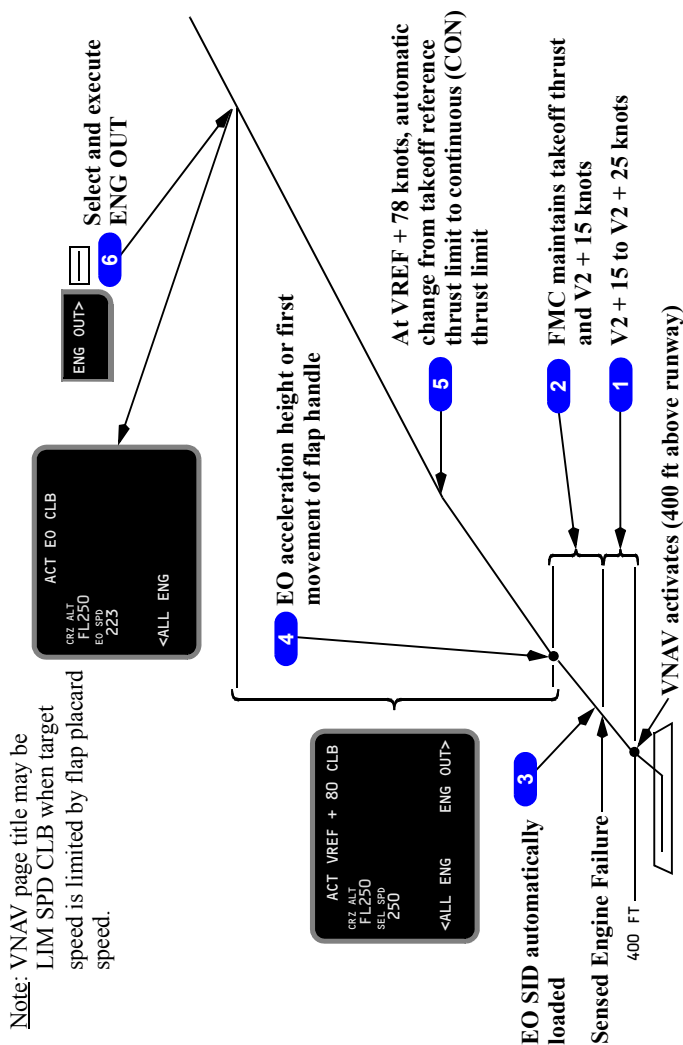
6 Missed Approach

When selected during missed approach, VNAV activates in VNAV SPD.

7 Missed Approach Level Off

At missed approach altitude, VNAV SPD changes to VNAV PTH.

Takeoff and Climb (Engine Out)



1 Takeoff

Condition: before a sensed engine failure and above VNAV activation altitude.

Result: VNAV SPD commands a climb at V2+15 to V2+25 knots. Autothrottle annunciation is THR REF and the thrust limit is takeoff.

2 Sensed Engine Failure

Condition: after VNAV activation, engine failure is sensed, airplane below engine out acceleration height and below the thrust reduction point entered on the TAKEOFF REF page.

Result: VNAV remains in VNAV SPD and commands $V_2 + 15$ knots. Autothrottle remains in THR REF and the thrust limit remains takeoff (TO).

3 EO SID

Condition: flaps extended and an engine out standard instrument departure (EO SID) in the FMC database.

Result: FMC loads the EO SID as a flight plan modification. The modification may be either executed or erased.

4 Acceleration Height

Condition: at acceleration height or flap retraction has started.

Result: VNAV commands an acceleration to $V_{REF} + 80$ knots, limited by the airplane configuration (flap placard). Pushing the VNAV function key displays the ACT $V_{REF} + 80$ CLB page.

5 Thrust Reduction

Condition: airplane has accelerated to $V_{REF} + 78$ knots

Result: thrust is automatically reduced from selected takeoff to continuous (CON) thrust. If the engine failure occurs above the thrust reduction point, the current climb thrust is maintained.

6 VNAV Climb (Engine Out)

Condition: Select the ENG OUT> prompt on the VNAV CLB page to display the applicable engine out performance data. The airline company engine out company speed (CO SPD) or long range cruise (LRC) speed may be selected. Execute to make the data active.

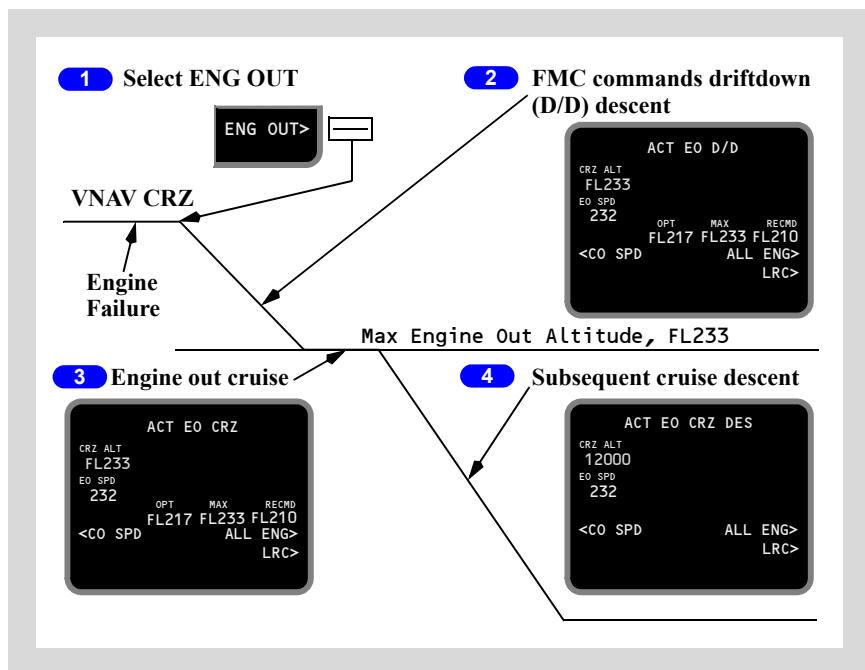
Result: FMC engine out climb function is active, VNAV is in VNAV SPD, CON thrust is selected, if not previously selected. A different thrust limit may be selected on the THRUST LIM page.

Climb (Engine Out above EO Max Alt)

When the airplane is above the engine out maximum altitude, selection of the ENG OUT> prompt on the VNAV CLB page creates a modification and displays the applicable engine out driftdown (D/D) performance data to enable the airplane to descend to the engine out maximum altitude. Execution of the modification activates the engine out driftdown function.

Cruise (Engine Out Above EO Max Alt)

Selection of ENG OUT> may also be accomplished on the XXXX ALTN page in conjunction with a diversion modification.



1 Engine Out Modification

Condition: Select the ENG OUT> prompt on the VNAV CRZ page.

Result: The FMC creates a modification and displays the applicable engine out driftdown (D/D) performance data to enable the airplane to descend to the engine out maximum altitude.

2 Drift Down Execution

Condition 1: Set the MCP altitude at or below EO MAX altitude and execute the FMC modification. This condition assumes clearance is approved to descend slowly to a non-standard altitude; for example, FL233.

Result: The reference thrust limit becomes CON, VNAV commands a very shallow descent in VNAV SPD as the airplane decelerates to EO SPD, the EO MAX altitude becomes the cruise altitude at 1L, and the autothrottle sets CON thrust on the operative engine. Time and distance for the D/D to EO MAX altitude display at 2R.

Two other ways to activate the EO D/D (to the clearance altitude) are discussed below.

Condition 2: Execute the ENG OUT modification. Then, set the clearance altitude (lower than EO MAX) in the MCP and push the MCP altitude selector.

Result: The airplane remains at the MCP altitude until the altitude is set lower and the MCP altitude selector is pushed, the pitch mode initially changes to VNAV ALT, the reference thrust limit becomes CON, and the autothrottle adjusts thrust on the operative engine to maintain FMC-commanded EO SPD. After setting the MCP altitude window and pushing the altitude selector, the operative engine increases thrust to CON and the airplane descends in a VNAV SPD driftdown to the clearance altitude in 1L. Initial descent rate is low, depending on the gross weight and on how much the airspeed has decreased before pushing the altitude selector. If the airspeed has decreased below EO SPD, the descent rate increases to regain the airspeed.

Condition 3: Set the clearance altitude (lower than EO MAX) in the MCP, push the altitude selector; then, after the descent is established, execute the FMC modification (ENG OUT selection).

Result: After pushing the altitude selector, the airplane descends in a normal VNAV SPD cruise descent at two-engine cruise speed. The reference thrust limit is CLB/CRZ and the autothrottle maintains cruise descent airspeed. The cruise altitude is set to the MCP altitude when the altitude selector is pushed. Executing the FMC modification while above EO MAX altitude sets the driftdown descent airspeed to EO SPD. The reference thrust limit becomes CON and the autothrottle increases thrust to CON on the operative engine. The airplane initially descends at economy cruise airspeed and approximately 1,250 fpm. After executing the ENG OUT modification, the commanded airspeed is EO SPD. The rate of descent decreases to a minimum of 300 fpm.

3 Engine Out Cruise

When VNAV captures the EO MAX altitude (Condition 1 only), the VNAV cruise page title becomes EO CRZ and the pitch annunciation is VNAV PTH, regardless of the MCP altitude window setting. Predictions for EO Step Climb display at 2R. Thrust limit remains in CON.

4 Subsequent Cruise Descent

Condition: FMC in engine out mode, more than 50 nm from T/D, set a lower MCP altitude, push the altitude selector.

Result: VNAV cruise descent at approximately 1,250 fpm at EO SPD. When the EO cruise descent intersects the planned descent profile, descent mode becomes active.

Required Time of Arrival (RTA)

VNAV controls cruise speed to arrive at a specified waypoint within ± 30 seconds of a specified time. If the RTA is not achievable, the FMC displays the scratchpad message UNABLE RTA.

Data Entry Rules

Altitude Entry

Altitudes can be entered into the FMC as three digit (XXX), four digit (XXXX), five digit (XXXXX), or flight level (FLXXX) numbers. The FMC displays altitude or flight level entries in the proper form based on the transition altitude. Some data lines further restrict the valid entry forms.

Three digit entries represent altitude or flight levels in increments of 100 feet. Leading zeros are required.

Examples of three digit (XXX, FLXXX) entries with transition altitude = 10,000 feet:

- 800 feet is entered as 008 or FL008; displays as 800
- 1,500 feet is entered as 015 or FL015; displays as 1500
- 11,500 feet is entered as 115 or FL115; displays as FL115
- 25,000 feet is entered as 250 or FL250; displays as FL250

Four digit entries represent feet, rounded to the nearest ten feet. Leading zeros are required. This form is used when the altitude does not exceed 9,994 feet.

Examples of four digit (XXXX) entries with transition altitude = 18,000 feet:

- 50 feet is entered as 0050; displays as 50
- 835 feet is entered as 0835; displays as 840
- 1,500 feet is entered as 1500; displays as 1500
- 8,500 feet is entered as 8500; displays as 8500
- 9,994 feet is entered as 9994; displays as 9990

Five digit entries represent feet, rounded to the nearest ten feet. This form is used when the altitude exceeds 9,994 feet.

Examples of five (XXXXX) digit entries with transition altitude = 4,000 feet:

- 50 feet is entered as 00050; displays as 50
- 835 feet is entered as 00835; displays as 840
- 1,500 feet is entered as 01500; displays as 1500
- 8,500 feet is entered as 08500; displays as FL085
- 9,995 feet is entered as 09995; displays as FL100
- 11,500 feet is entered as 11500; displays as FL115
- 25,000 feet is entered as 25000; displays as FL250

Negative altitude entries are allowed to -1000 feet.

Airspeed Entry

Airspeeds can be entered into the FMC as calibrated airspeed, CAS, or Mach number, M. Calibrated airspeeds are entered as three digits (XXX) in knots. Mach numbers are entered as one, two, or three digits following a decimal point.

Data Pairs

Many CDU pages display data in pairs separated by a slash “/.” Examples of these pairs include wind direction/speed and waypoint airspeed/altitude constraints. When entering both values in a pair, the slash is inserted between the values. When it is possible to enter only one value of the pair, the slash may not be required. When entering only the outboard value of a pair, the trailing or leading slash may be entered, but is not required before transferring to the data line. When entering the inboard value of a pair, the trailing or leading slash must be entered before transferring to the data line. Omission of the required slash normally results in an INVALID ENTRY message.

Intentionally
Blank

**Flight Management, Navigation
Flight Management Computer****Chapter 11
Section 32**

FMC Databases

The FMC contains three databases:

- performance
- navigation
- airline modifiable information (AMI).

The performance database supplies performance data to the flight crew. It supplies the FMC with data to calculate pitch and thrust commands. All pertinent data can be displayed on the CDU. The database includes:

- airplane drag and engine characteristics
- maximum and optimum altitudes
- maximum and minimum speeds.

The navigation database includes most data found on navigation charts. This data can be displayed on the CDU or ND. The database contains:

- location of VHF navigation aids
- airports
- runways
- other airline selected data, such as SIDs, STARs, approaches, and company routes
- transition altitudes.

The FMC contains two sets of navigation data, each valid for 28 days. Each set corresponds to the usual navigation chart revision cycle. The FMC uses the active data for navigation calculations. The contents of the navigation database are periodically updated and transferred to the FMC before the expiration date of the active data.

The AMI file contains airline specified data. If the FMC senses a conflict in an AMI value after a new AMI data load, the scratchpad displays the message CHECK AIRLINE POLICY.

Thrust Management

The thrust management function operates the autothrottle in response to flight crew mode control panel inputs or to FMC commands. Reference thrust limits can be selected on the THRUST LIM page. FMC autothrottle commands are made while VNAV is engaged. Thrust management:

- calculates reference thrust limits and thrust settings, or follows FMC thrust settings
- commands thrust levers

- senses and transmits autothrottle failures
- commands thrust equalization through the engine electronic controls.

[PW, RR Engines]

Thrust limits are expressed as EPR limits. Thrust equalization references EPR.

[GE Engines]

Thrust limits are expressed as N1 limits. Thrust equalization references N1.

Thrust management calculates a reference thrust for the following thrust settings:

[Option – With Takeoff Thrust Derate, Climb Derates, Takeoff Bump]

- | | |
|--|---|
| • TO – takeoff | • TO B – takeoff bump
(increased takeoff thrust) |
| • TO 1 – takeoff one | • CLB – climb |
| • TO 2 – takeoff two | • CLB 1 – climb one |
| • D–TO – assumed temperature
takeoff | • CLB 2 – climb two |
| • D–TO 1 – derate one assumed
temperature takeoff | • CRZ – cruise |
| • D–TO 2 – derate two assumed
temperature takeoff | • CON – continuous |
| | • G/A – go-around. |

[Option-With APU-to-Pack takeoff thrust limit]

In addition, with the APU-to-Pack takeoff option, “A-TO”, “A-TO 1”, “A-TO 2”, or “A-TO B” thrust setting displays.

[PW, RR Engines]

With VNAV active, the reference thrust limit changes for the phase of flight. Thrust settings can be selected on the THRUST LIM page. The reference thrust limit displays above EICAS EPR indications.

[GE Engines]

With VNAV active, the reference thrust limit changes for the phase of flight. Thrust settings can be selected on the THRUST LIM page. The reference thrust limit displays above EICAS N1 indications.

The flight crew can specify the thrust reduction height where the change from takeoff to climb thrust takes place by making an entry on the CDU TAKEOFF REF page. This can be an altitude from 400 feet to 9,999 feet, an entry of 1 for Flaps 1, or an entry of 5 for flaps 5.

Reduced Thrust Takeoff

Reduced thrust takeoffs lower EGT and extend engine life.

Derate/Variable Takeoff Rating

[Option – With Takeoff Thrust Derate]

Two fixed derates can be selected on the THRUST LIM page. TO 1 and TO 2 reduce takeoff thrust by percentages specified by the operator [Airline Selectable Option]. The derate percentages can be set between maximum takeoff thrust and the maximum certified derate in one percent increments. The Airplane Flight Manual (AFM) provides performance data for these derates.

With both TO 1 and TO 2, the thrust setting parameter is considered a limitation for takeoff; therefore, thrust levers should not be advanced further except in an emergency. A further thrust increase following an engine failure could result in a loss of directional control. Use the takeoff speeds calculated by the FMC for the selected derate or variable takeoff rating condition.

Derate/variable takeoff rating can be further reduced by assumed temperature.

Assumed Temperature Thrust Reduction Takeoff

Entering an assumed temperature higher than the actual temperature reduces takeoff thrust.

The maximum thrust reduction authorized is 25 percent below any certified rating. Do not use assumed temperature reduced thrust if conditions exist that affect braking, such as slush, snow, or ice on the runway, or if potential windshear conditions exist.

[Option - With Deep Derate Takeoff Thrust]

The maximum thrust reduction authorized is 40 percent below the full rating. With this option, fixed takeoff derates are not available. Do not use assumed temperature reduced thrust if conditions exist that affect braking, such as slush, snow, or ice on the runway, or if potential windshear conditions exist.

The assumed temperature thrust setting is not considered a limitation. The assumed temperature reduction can be removed. If conditions are encountered where more thrust is necessary, the crew can manually apply full thrust.

Derated Thrust Climb

[Option – With Climb Thrust Derate]

During climb, CLB 1 and CLB 2 derates are gradually removed. In cruise, the thrust reference defaults to CLB or CRZ [Airline Selectable Option]. The reference can be manually selected on the THRUST LIM page.

[Option – 12,000 Feet Washout]

Two fixed climb thrust derates can be selected on the THRUST LIM page. CLB 1 uses a 10 percent derate of CLB thrust to 10,000 feet, then increases thrust linearly with altitude to CLB thrust at 12,000 feet. CLB 2 uses a 20 percent derate of CLB thrust to 10,000 feet, then increases thrust linearly with altitude to CLB thrust at 12,000.

[Option – 30,000 Feet Washout]

Two fixed climb thrust derates can be selected on the THRUST LIM page. CLB 1 uses a 10 percent derate of CLB thrust to 10,000 feet, then increases thrust linearly with altitude to CLB thrust at 30,000 feet. CLB 2 uses a 20 percent derate of CLB thrust to 10,000 feet, then increases thrust linearly with altitude to CLB thrust at 30,000 feet.

Use of an assumed temperature reduced thrust takeoff or takeoff derate affects automatic selection of climb derate. For a thrust reduction less than 10 percent, maximum climb thrust is automatically selected by the FMC. For takeoff thrust reductions or derates from 10 percent to less than 20 percent, CLB 1 is selected. CLB 2 is selected for all takeoff thrust reductions or derates equal to or greater than 20 percent. On the ground, the pilots may override the automatic climb derate selection after the takeoff selection is complete.

Use of derated climb thrust reduces engine maintenance costs, but increases total trip fuel.

Fuel Monitoring

The FMC receives fuel data from the fuel quantity system or from manual entries. Fuel quantity values display on the PERF INIT page as calculated (CALC), MANUAL, or SENSED. They display on PROGRESS page 2 as TOTALIZER and CALCULATED. TOTALIZER and SENSED values are the same data with different names.

The FMC usually uses the calculated value for performance computations. Before engine start, the calculated value is set to agree with the fuel quantity indicating system value. When the FMC receives a positive fuel flow signal at engine start, the calculated value is independent of the fuel quantity system and decreases at the fuel flow rate.

During fuel jettison, the calculated value is set equal to the fuel quantity system value. When fuel jettison is completed, the calculated value is independent of the fuel quantity indicating system and decreases at the fuel flow rate. This fuel quantity value displays as CALC (calculated) on the PERF INIT page and CALCULATED on PROGRESS page 2.

If the flight crew inputs a fuel quantity, the line title changes to MANUAL and replaces the calculated value. Like the calculated value, the manual value is updated by fuel flow rate.

The calculated value is invalid if fuel flow data is invalid. The FMC uses the fuel quantity indicating system quantity for performance computations. The line title on the PERF INIT page changes to SENSED and displays as TOTALIZER on PROGRESS page 2.

The fuel used by each engine is calculated with its related fuel flow signal. FUEL USED displays on PROGRESS page 2. FUEL USED values are retained through flight completion and are subsequently cleared at engine start or following a long-term power interrupt on the ground. If the fuel flow signal is invalid for greater than two minutes after engine start or is invalid while on the ground, the display blanks.

The FMC continually estimates the fuel at the destination airport if the active route is flown. The CDU message INSUFFICIENT FUEL displays if the estimate is less than the fuel reserve value entered on the PERF INIT page.

Note: FMC calculated fuel predictions assume a clean configuration. Flight with gear or flaps extended cause fuel prediction errors. Fuel predictions are accurate after the gear and flaps are retracted.

If the actual fuel temperature reaches the minimum value displayed on the PERF INIT page, the EICAS advisory message FUEL TEMP LOW displays.

Loss of FMC Electrical Power

The FMC must have continuous electrical power to operate. When the electrical power is interrupted and returns, the FMC restarts.

After restart, the performance data displayed on the PERF INIT page must be re-entered. The route previously in use is available but must be reactivated.

The flight crew must modify the active waypoint to activate LNAV. Selecting the applicable active waypoint and proceeding direct or intercepting a course to the waypoint allows LNAV activation.

FMC Failure

Single FMC Failure

The scratchpad message SINGLE FMC L or SINGLE FMC R displays after loss of a single FMC. The EICAS advisory message FMC MESSAGE displays. Crew action is not necessary to change to single FMC operation. LNAV and VNAV, if active, remain active and all flight plan and performance data is retained.

A software reset may occur while in single FMC operation. The active route becomes inactive, the performance data is erased, and LNAV and VNAV (if engaged) modes fail. To regain FMC operation, activate and execute the flight plan, enter the necessary performance data, and engage LNAV and VNAV.

Note: If the MENU page and the scratchpad message TIMEOUT RESELECT display, the FMC is no longer connected to the CDU. Selecting the <FMC prompt connects the CDU to the FMC.

Dual FMC Failure

If both FMCs fail, LNAV and VNAV fail. The EICAS advisory message FMC displays. The CDUs supply route data to the NDs, and one of the CDUs supplies LNAV guidance to the autopilot. LNAV can be reselected on the mode control panel. FMS alternate navigation using the CDUs is discussed in Section 50 of this chapter.

Dual FMC failure may inhibit the autothrottle system. If it is available, it may be used in conjunction with any valid autopilot roll and/or pitch mode.

Note: If the MENU page displays and the <FMC prompt is not displayed in line 1, pushing the LEGS function key displays the ALTN NAV LEGS page, the PROG key displays the ALTN NAV PROGRESS page, and the NAV RAD key displays the ALTN NAV RADIO page.

Flight Management, Navigation**Chapter 11****Air Traffic Control Data Link****Section 33**

Air Traffic Control Data Link

Most Air Traffic Control data link functions are accomplished on the MFD. The CDU is used as an input keyboard for downlink message forms. Uplink messages which contain route modifications are loaded into the FMC using the LOAD FMC function on the MFD ATC page. Execution of an ATC loaded modification is accomplished using normal FMC modification procedures.

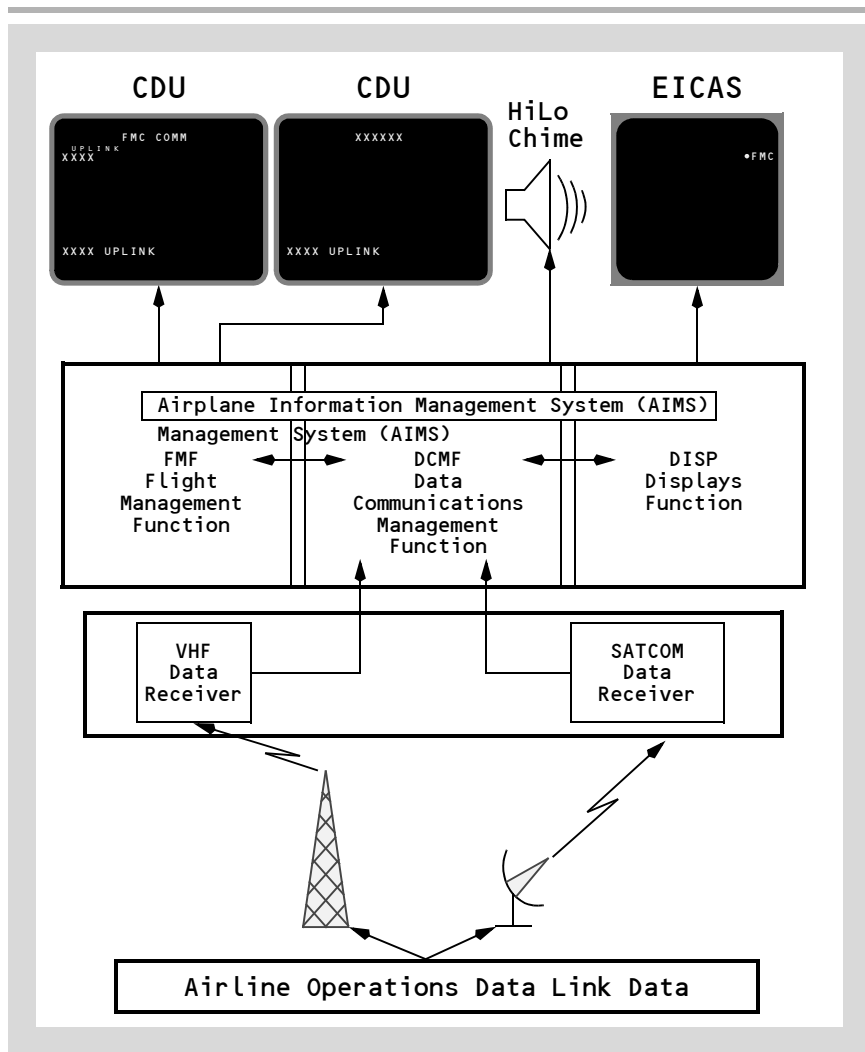
Refer to chapter 5, Communications, section 40, MFD Communications, for a description of ATC data link.

Intentionally
Blank

**Flight Management, Navigation
Company Data Link****Chapter 11
Section 34**

Company Data Link

The airplane communications system enables two-way data link communications between the FMC and airline operations. A downlink occurs when data is transferred from the FMC and transmitted through the airplane communications system to a receiver on the ground. Data may be downlinked from the FMC either manually or automatically. An uplink is the opposite of a downlink; data is transmitted from a ground station for input to the FMC. Data may be uplinked at the discretion of the airline operations dispatcher or in response to a downlink request.



Data Link

Downlinks are data link messages transmitted to a ground station. Requests for data and reports of FMC data are two types of downlinks. Requests are made manually by the flight crew. Reports can be made manually or may occur automatically.

Uplinks are messages transmitted to the airplane. Most uplinks require manual selections by the flight crew. Some uplinks are input automatically.

Manual Downlinks

[Option – With Takeoff Datalink]

Select a REQUEST prompt to start the downlink request for data. REQUEST prompts are on PERF INIT, TAKEOFF REF, DESCENT FORECAST, RTE, ALTN, ALTN LIST, or RTE DATA pages. Downlink reports of the active route may be accomplished by selection of the REPORT prompt on the RTE page and a position report may be downlinked by selection of the REPORT prompt on the POS REPORT page.

When the communications function is unable to prepare FMC downlinks, the words FAIL, NO COMM, or VOICE display on CDU pages in place of REQUEST and REPORT prompts. The data link status also displays on the FMC COMM page. Radios supporting data link operations can be reconfigured by the crew through the MFD COMM function; refer to Chapter 5, Communications. The status messages are:

- FAIL –
 - the AIMs data communications management function is inoperative, or
 - both the VHF and SATCOM data radios have failed.
- NO COMM –
 - the VHF and SATCOM data radios are operational but not available
 - the VHF data radio has failed and the SATCOM data radio is not available, or
 - the SATCOM data radio has failed and the VHF data radio is not available.
- VOICE – all available radios are operating in the VOICE mode.

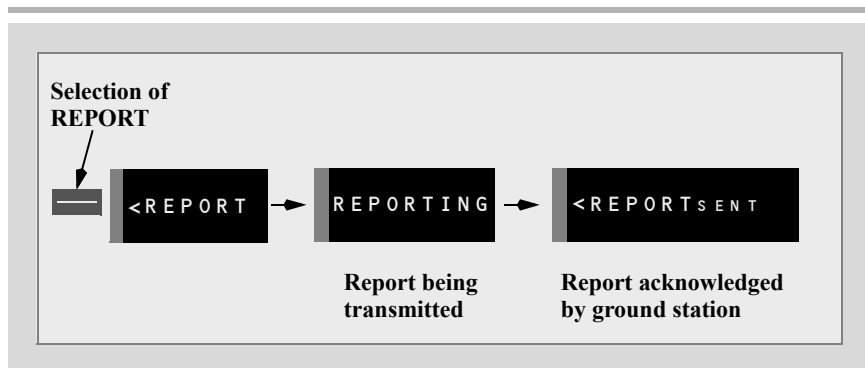
Reports

Pushing the line select key for the REPORT sends a downlink report applicable to that page. The pages below contain report prompts.



Report Status

Below is a typical sequence of status in response to sending a report.



Automatic Downlinks

The FMC can be configured by the airline to automatically transmit downlinks of FMC data at predetermined points during the flight or in response to specific data requests from the airline dispatcher. The FMC response in these cases is completely automatic and no flight crew action is necessary.

Uplinks

Uplinked data may be loaded automatically or may require flight crew action. Two uplinks automatically load data into the FMC and do not require execution. Uplinked data that waits in system memory for flight crew action are considered to be pending.

A pending uplink is included or discarded when the flight crew selects the applicable prompt. Flight crew response to an uplink depends on the type of uplink. Flight crew action is made with ACCEPT/REJECT or LOAD/PURGE prompts, FMC modification ERASE prompt or EXEC key, or when the page with the uplink is selected. Glareshield-mounted accept and reject switches operate the same as MFD ACCEPT/REJECT prompts.

[\[Option – With Takeoff Data Link\]](#)

Data can be uplinked from the airline dispatcher directly to the PERF INIT, TAKEOFF REF, DESCENT FORECAST, RTE, ALTN, ALTN LIST, and WIND pages. The uplinks are annunciated to the crew by the •FMC EICAS communications alert and a Hi–Lo Chime. The uplink is identified by a CDU scratchpad message and by the presence of an UPLINK label over the applicable COMM page prompt.

[\[Option – With Takeoff Data Link\]](#)

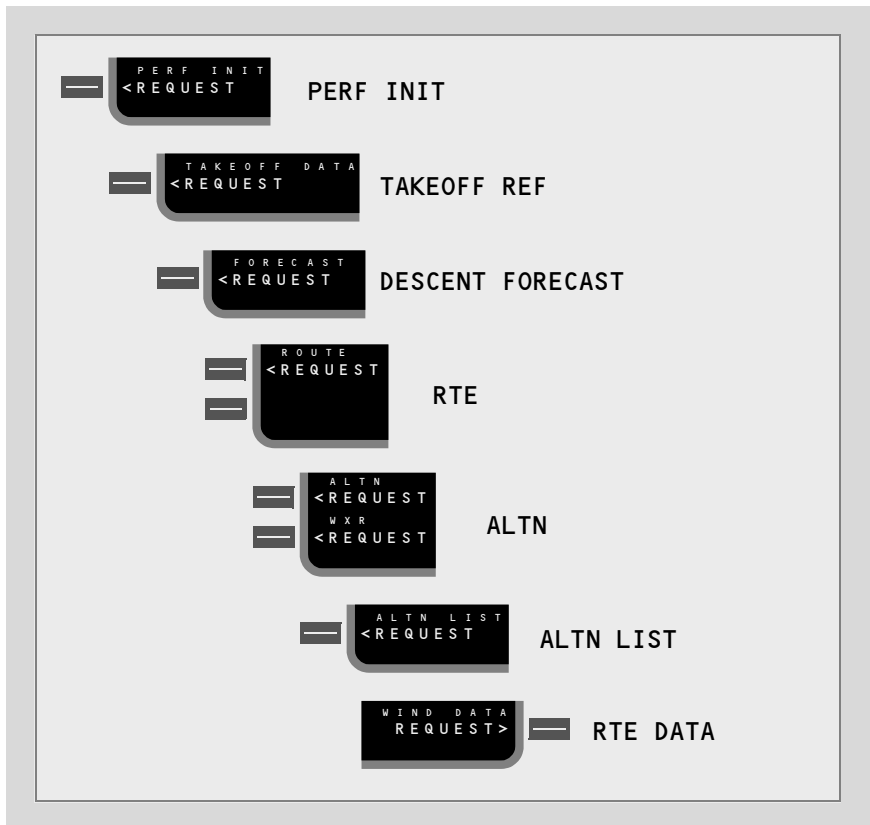
Takeoff uplinks are not annunciated until:

- gross weight is entered on the PERF INIT page
- a route is activated
- the active route has a departure runway (and intersection, if applicable) matching the TAKEOFF uplinks (up to six takeoff records can be uplinked).

If there is no active route, wind uplinks are not annunciated, and the <WIND prompt on the COMM page is not shown.

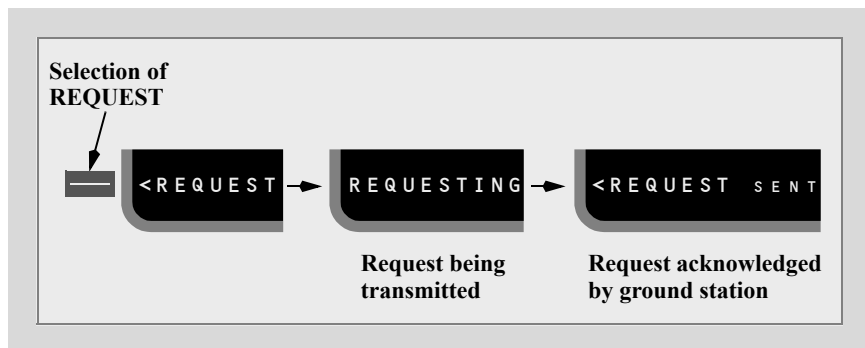
Requests

A REQUEST prompt on each page downlinks a unique request applicable to that page. The pages below contain request prompts.

[\[Option – With Takeoff Data Link\]](#)

Request Status

Below is a typical sequence of status in response to sending a request.



FMC Data Link Uplinks (Accept/Reject)

[Option – With Takeoff Data Link]

ACCEPT and REJECT display on the PERF INIT, TAKEOFF 1/2, and ALTN pages after receipt of uplink data.

Uplink data displays initially in small font for preview.

Select ACCEPT prompt:

- displays uplinked data in large font
- replaces previous data with uplinked data
- changes page to pre-uplink format
- clears scratchpad message
- transmits a downlink accept message (if enabled).

Select REJECT prompt:

- replaces uplinked data with previous data
- changes page to pre-uplink format
- clears scratchpad message
- transmits a downlink reject message (if enabled).



FMC Data Link Uplinks (Load/Purge)

LOAD and PURGE display on the DESCENT FORECAST page after receipt of uplink data. LOAD and PURGE display on the active RTE 1 or RTE 2 page when there is an uplink to the inactive route.

Select LOAD prompt:

- loads uplinked data into FMC for viewing
- clears scratchpad message
- replaces previous data with uplinked data
- changes page to pre-uplink format
- transmits a downlink accept message (if enabled).

Select PURGE prompt:

- replaces uplinked data with previous data
- changes page to pre-uplink format
- clears scratchpad message
- transmits a downlink reject message (if enabled).

FORECAST UPLINK
<LOAD PURGE>
DES FORECAST UPLINK READY

ROUTE UPLINK
<LOAD PURGE>
ROUTE X UPLINK READY

Uplink To Inactive Route

FMC Data Link Uplinks (Load/Exec-Erase)

LOAD displays on the RTE and WIND pages after receipt of uplink data.

After the uplinked data is loaded, the EXEC light illuminates and the ERASE prompt displays.

Select LOAD prompt:

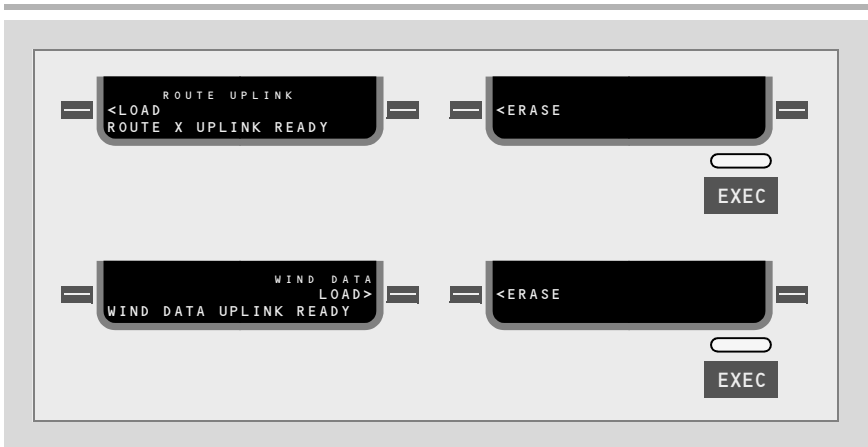
- loads uplinked data into FMC
- loaded data can be viewed
- clears scratchpad message
- replaces existing data with modified uplinked data
- changes page title to MOD
- shows ERASE prompt
- illuminates EXEC light

Push the EXEC key to:

- put modified data in active flight plan
- change page format to pre-uplink format
- transmit a downlink accept message (if enabled).

Select ERASE prompt to:

- remove modified data
- return page display to pre-uplink format
- transmit a downlink reject message (if enabled).



FMC Data Link Uplinks (Automatic)

FLT NO and ALTN LIST data can be automatically uplinked and loaded. FLT NO automatically loads into the RTE 1/x page without flight crew action. The list of 20 alternates automatically loads into the ALTN LIST page without flight crew action.

The scratchpad messages FLIGHT NUMBER UPLINK or ALTN LIST UPLINK stay in the scratchpad display queue until the applicable CDU page is selected.



Data Link Management

The flight crew should monitor system status of FMC data link. This is accomplished on various CDU pages or on the FMC COMM page. Changes to data link system operating modes are accomplished with the COMM function on the display select panel.

CDU Data Link Status Displays

Data link operation is verified when the correct line title displays above the prompt. In the example below, the line title ROUTE is above the REQUEST and REPORT prompts on the RTE page.



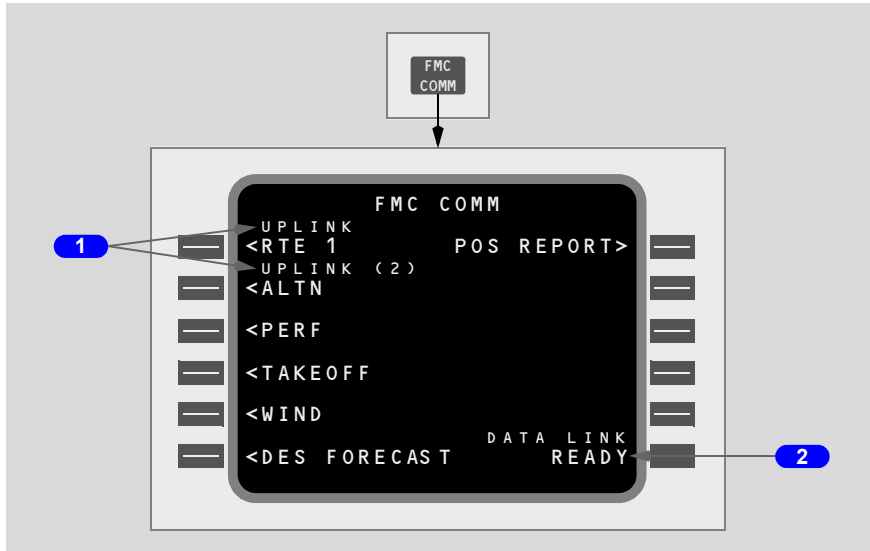
When the data link system is not operating, the CDU data line changes to NO COMM, VOICE, or FAIL and the line title changes to DATA LINK.



FMC Communications Page

General data link status displays on the FMC COMM page. Page select prompts display for each FMC page with access to data link data.

[Option – With Takeoff Data Link]



1 Uplink Status

[Option – With Takeoff Data Link]

The page line title displays UPLINK when an uplink message is pending and all preprocessing is complete. Preprocessing of uplinks ensures prerequisite data is available before the uplink message can be selected. Examples of preprocessing include:

- RTE ALTN, ALTN LIST, PERF, TAKEOFF, and WIND uplinks are held until route activation or modifications are complete
- Subsequent uplinks of the same type are held until previous uplinks are included or discarded by the flight crew
- TAKEOFF uplink is held until gross weight is entered, a pending PERF uplink is included or discarded, or a takeoff runway is entered

When both ALTN and ALTN LIST uplinks are pending, (2) displays to the right of UPLINK in the line title.

The EICAS message •FMC displays whenever any UPLINK message is pending.

2 DATA LINK

Displays the data link system status.

System status can be:

- READY
- NO COMM
- VOICE
- FAIL.

Page Select Prompts

[\[Option – With Takeoff Data Link\]](#)

Selection of any of these prompts displays the related page:

- | | |
|-----------|----------------|
| • RTE X | • WIND |
| • ALTN | • DES FORECAST |
| • PERF | • POS REPORT. |
| • TAKEOFF | |

Flight Management, Navigation
FMC Preflight**Chapter 11**
Section 40

Introduction

Completion of the FMC preflight requires data entry in all minimum required data locations. Entry of all required and optional preflight data optimizes FMC accuracy.

Data link can load preflight data from airline ground stations. Using data link reduces the number of required flight crew actions. Manual flight crew entries replace existing data.

Data link can also be used to load takeoff data onto the TAKEOFF REF pages.

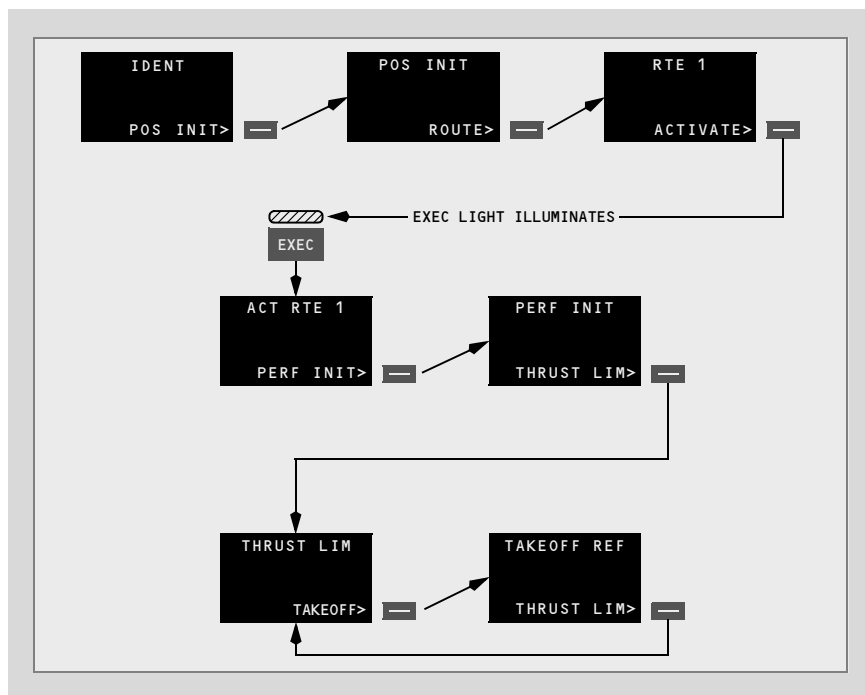
Preflight Page Sequence

The identification page usually displays when power is applied to the FMC. Preflight flow continues in this sequence:

- identification (IDENT) page
- position initialization (POS INIT) page
- route (RTE) page
- DEPARTURES page (no prompt)
- navigation radios (NAV RAD) page (no prompt)
- performance initialization (PERF INIT) page
- thrust limit (THRUST LIM) page
- takeoff reference (TAKEOFF REF) page

Some of these pages are also used in flight.

Minimum Preflight Sequence



During preflight, a prompt in the lower right directs the flight crew through the minimum requirements for preflight completion. Selecting the prompt key displays the next page in the flow. If a required entry is missed, a prompt on the TAKEOFF page leads the flight crew to the preflight page missing data.

Airplane inertial position is necessary for FMC preflight and flight instrument operation.

A route must be entered and activated. The minimum route data is origin and destination airports, and a route leg.

Performance data requires entry of airplane weights, fuel reserves, cost index, and cruise altitude.

Takeoff data requires a flap setting and center of gravity.

Supplementary Pages

Supplementary pages are sometimes required. These pages have no prompts and interrupt the usual sequence. Discussions of each page includes methods to display the page.

When the route includes SIDs and STARs, they can be entered using the DEPARTURES or ARRIVALS pages.

Route discontinuities are removed and the route is modified on the ROUTE and RTE LEGS pages. Speed/altitude restrictions are entered and removed on the RTE LEGS page. The RTE LEGS page is described in the FMC Cruise section of this chapter.

Alternate airports are added on the ALTN page. The ALTN page is described in the FMC Descent/Approach section of this chapter.

Waypoints, navigation, airport, and runway data is referenced on the REF NAV DATA page. The REF NAV DATA page is described in the FMC Cruise section of this chapter.

Fixed takeoff thrust derates can be changed on the AIRLINE POLICY page.

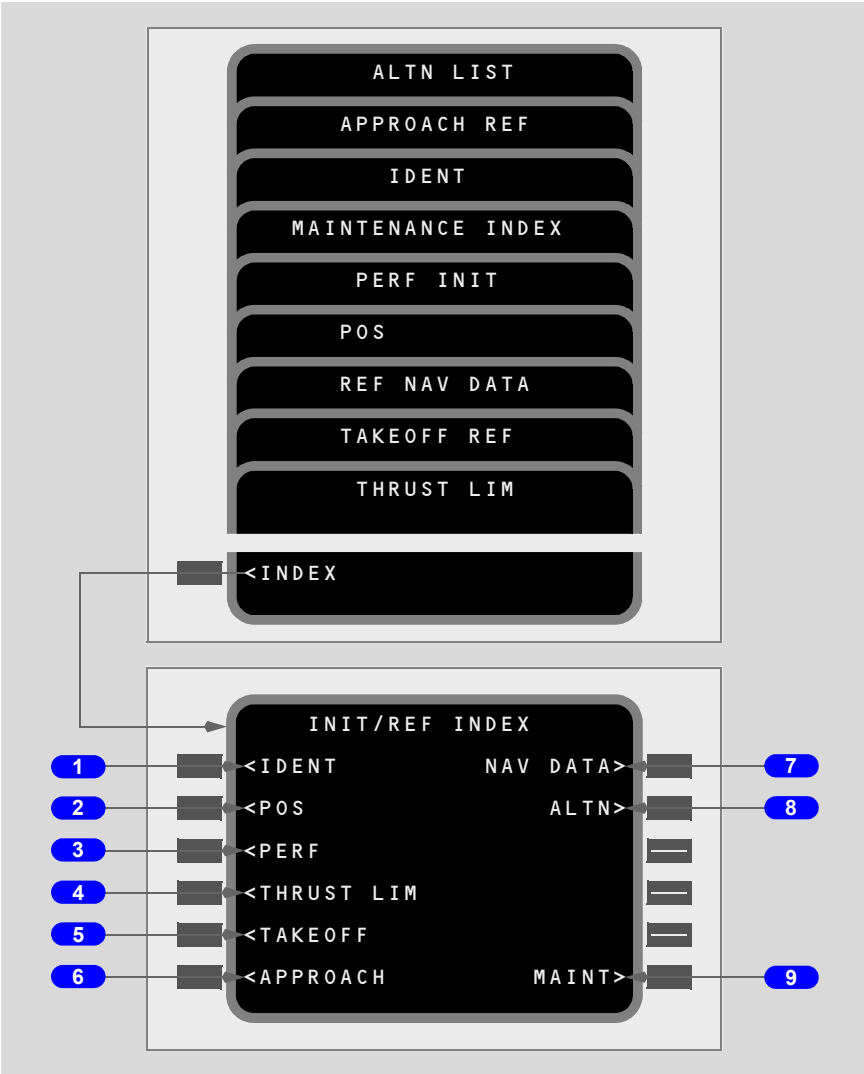
VNAV performance is improved if forecast winds and temperatures are entered during the preflight. Wind and temperature data for specific waypoints is entered on the WIND page. The WIND page is described in the FMC Cruise section of this chapter.

Preflight Pages – Part 1

The preflight pages are presented in the sequence used during a typical preflight.

Initialization/Reference Index Page

The initialization/reference index page allows manual selection of FMC pages. It gives access to pages used during preflight and not usually used in flight.



1 Identification (IDENT)

The IDENT page is used to verify basic airplane data and currency of the navigation database.

2 Position (POS)

The POS INIT page is used for ADIRU initialization.

The POS INIT page is also used for initialization of SAARU heading in the event the ADIRU fails.

3 Performance (PERF)

The PERF INIT page is used for initialization of data required for VNAV operations and performance predictions.

4 Thrust Limit (THRUST LIM)

The THRUST LIM page is used to select thrust limits and derates.

5 TAKEOFF

The TAKEOFF REF page is used to enter takeoff reference data and V speeds.

6 APPROACH

The APPROACH REF page is used for entry of the approach VREF speed.

7 NAV DATA

The REF NAV DATA page is used for data on waypoints, navaids, airports, and runways. NAV DATA pages are accessible only from this page.

8 Alternate (ALTN)

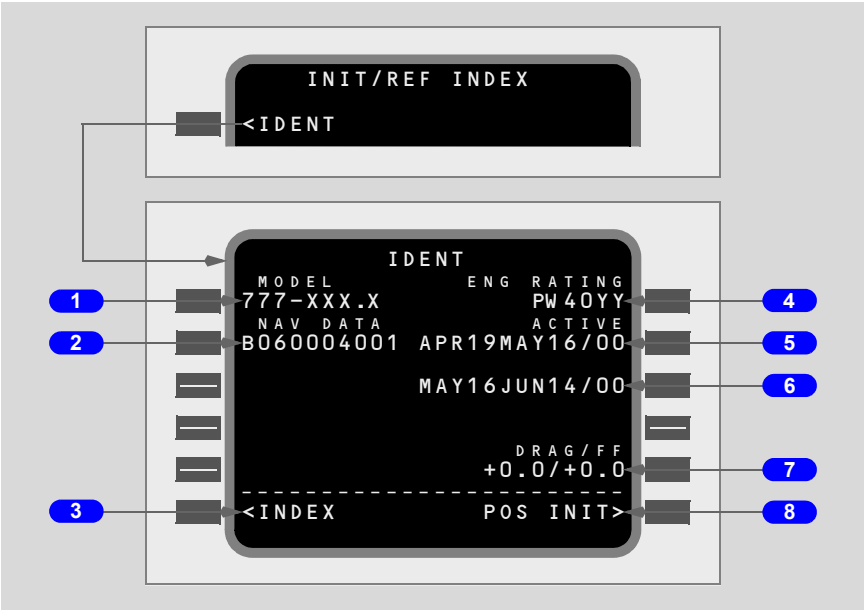
The ALTN page is used for alternate airport planning and diversions.

9 Maintenance (MAINT)

For maintenance use only; displays maintenance pages.

Identification Page

Most of the data on this page is for flight crew verification. The active navigation database can be selected.



1 MODEL

Displays airplane model as follows:

Ident Page Model	Airplane
777-200	777-200

Ident Page Model	Airplane
777-200.1	777-200ER

Ident Page Model	Airplane
777-200.2	777-200LR

Ident Page Model	Airplane
777-200.3	777-200ER with extended forward CG

777 Flight Crew Operations Manual

Ident Page Model	Airplane
777-200.4	777F

Ident Page Model	Airplane
777-300	777-300

Ident Page Model	Airplane
777-300.1	777-300ER

2 NAV DATA

Displays the navigation database identifier.

3 INDEX

Push – displays the INIT/REF INDEX page.

4 ENG RATING

Displays engine model and thrust rating. Header displays INTERMIX RATING for engine intermix installations. YY or YYY is the engine thrust rating.

5 ACTIVE

Displays the effectivity date range for the active navigation database.

If the active navigation database is out of date, it can be changed to the inactive navigation database. Pushing the date range prompt of the inactive navigation database copies that date into the scratchpad. Pushing the date range prompt of the active navigation database transfers the scratchpad date up to the ACTIVE database line. The previous active date moves to the inactive date line.

The line title ACTIVE is above the active navigation database date. No line title is above the inactive navigation database date. The navigation database date can only be changed on the ground. Changing the navigation database removes all previously entered route data.

When an active database expires in flight, the expired database is used until the active date is changed after landing. The data base expires at 0900Z on the last day in the range.

6 Inactive Date Range

Displays the effectivity date range for the inactive navigation database. This database becomes active at 0901Z on the first day in the range.

7 DRAG/FF

Displays the airplane drag and fuel flow correction factors.

8 Position Initialization (POS INIT)

Push – displays the POS INIT page.

Position Initialization Page 1/3

The position initialization page allows entry of airplane present position for ADIRU alignment. The same page is used to enter the heading for SAARU initialization when the ADIRU is inoperative.

Data on the first page is used to initialize the ADIRU. In the event the ADIRU becomes inoperative in flight, initialization of the SAARU heading is accomplished on this page.

The diagram illustrates the Position Initialization Page 1/3, showing three screens with numbered callouts 1 through 9.

Screen 1 (Top): Displays "INIT REF" and "Intertial Position Not Entered".

Screen 2 (Middle): Displays "INIT/REF INDEX" and "<POS".

Screen 3 (Bottom): Displays "POS INIT 1/3" and "LAST POS". The screen is divided into two sections: "REF AIRPORT" and "GPS POS".

Callouts:

- 1: REF AIRPORT
- 2: GATE
- 3: UTC 1430z
- 4: <INDEX
- 5: LAST POS
- 6: GPS POS
- 7: SET INERTIAL POS
- 8: ROUTE>
- 9: SET HDG

1 Reference Airport (REF AIRPORT)

Entry of the reference airport displays the airport latitude/longitude. Optional entry.

Valid entries are ICAO four letter airport identifiers.

Removes previous GATE entry.

Entry blanks at lift-off.

2 GATE

The gate entry allows further refinement of the latitude/longitude position.

Optional entry after reference airport entered.

Valid entry is a gate number at the reference airport.

Displays the latitude and longitude of the reference airport gate.

Changes to dashes when a new reference airport entered.

Entry blanks at lift-off.

3 Coordinated Universal Time (UTC)

UTC (GPS) – displays time from GPS.

UTC (MAN) –

- displays time from captain's clock when operative; otherwise, displays time from first officer's clock
- hours set by entering desired hour reference
- minutes set by resetting appropriate pilot's clock

4 INDEX

Push – displays the INIT/REF INDEX page.

5 Last Position (LAST POS)

Displays the last FMC calculated position.

6 GPS Position (GPS POS)

Displays the GPS present position. During preflight, the GPS POS may not display due to satellite availability, performance, or unfavorable geometry.

7 Set Inertial Position (SET INERTIAL POS)

The set inertial position entry is required to initialize the ADIRU. Select the most accurate latitude/longitude from LAST POS, REF AIRPORT, GATE, GPS POS, or make a manual entry to initialize the ADIRU.

If an entry is not made before the ADIRU completes the initial alignment, the scratchpad message ENTER INERTIAL POSITION displays.

If an entered position fails the ADIRU internal check, the scratchpad message ENTER INERTIAL POSITION displays. If the entered position fails the ADIRU check after the position is entered a second time, the scratchpad message ALIGNMENT REINITIATED displays.

The entered position is also compared with the FMC origin airport position. If the entered position is not within 6 NM of the FMC origin airport position, the scratchpad message INERTIAL/ORIGIN DISAGREE displays.

Dashes display when the ADIRU is in the automatic realignment mode and can receive a new position update. Enter the most accurate inertial position to remove any accumulated ADIRU position errors.

Enter airplane position latitude and longitude.

Boxes display within one minute of ADIRU power-up.

Blanks when the ADIRU changes from the alignment to the navigation mode.

Blanks when the airplane is moving or has not been stationary for a minimum of six minutes.

Dashes display when the ADIRU enters the automatic realignment mode on the ground.

New inertial position entries can be made after dashes display during ADIRU automatic realignment. New entries display for 2 seconds. After 2 seconds, dashes display to allow entry of another position.

8 ROUTE

Push – displays the ROUTE page.

9 SET HDG

Dashes display in flight when ADIRU is inoperative.

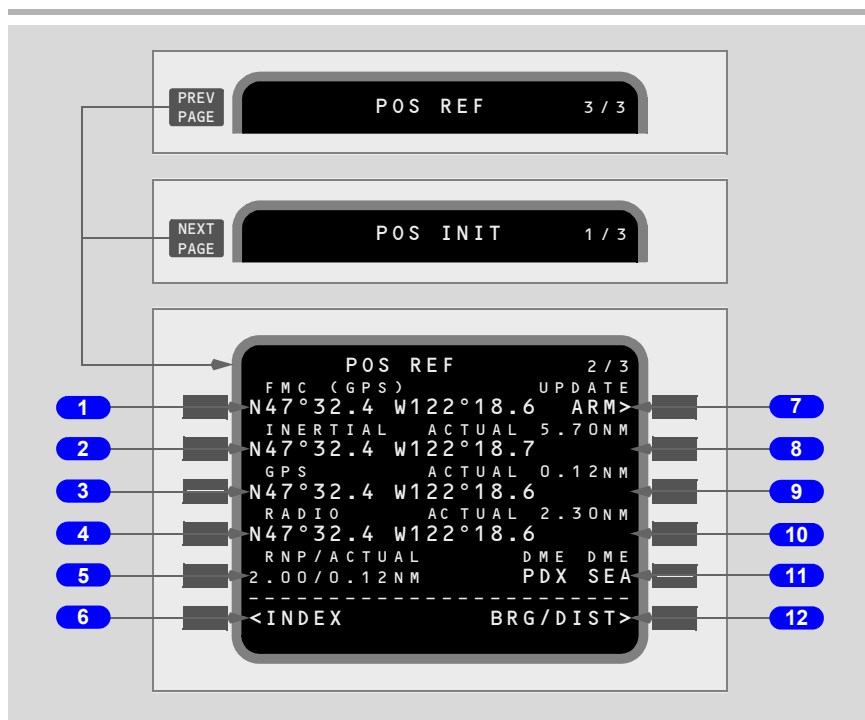
Entry of magnetic heading initializes SAARU.

Valid entry is 0 to 360 (0 or 360 displays as 360°). Entered heading displays in large font for two seconds, followed by dashes.

Position Reference Page 2/3

Position reference page 2 displays positions calculated by the FMC, ADIRU, GPS, and radio navigation receivers. The FMC position can be updated to ADIRU, GPS, or radio position on this page.

This page displays latitude/longitude or bearing/distance. All position displays are in actual latitude and longitude, as calculated by the related system. The ADIRU, GPS, and radio position data can be changed to bearing/distance.



1 FMC

The source used by the active FMC for position data displays next to the FMC line title. In the example, the FMC uses GPS for position data.

Displays the FMC calculated latitude/longitude.

Identifies the source for calculating the FMC position:

- GPS – position calculated from GPS position data
- INERTIAL – position calculated from ADIRU position data
- RADIO – position calculated from navigation radio position data
- LOC-RADIO or LOC-INERTIAL – position updated by localizer data

2 INERTIAL

Displays latitude/longitude position determined by the ADIRU.

3 GPS

Displays latitude/longitude position determined by the GPS.

4 RADIO

After airborne, displays latitude/longitude position determined by navigation radios.

5 Required Navigation Performance and Actual Navigation Performance (RNP /ACTUAL)

Displays RNP values stored in the navigation database for departure and arrival procedures; or, if there are none, displays the default values stored within the FMC by flight phase. Also displays FMC actual navigation performance (ACTUAL).

Default RNP is in small font.

Valid RNP entries are in the range 0.01 to 99.9. Manual entry displays in large font; propagated to 2L RNP PROGRESS page 4. ACTUAL entry not allowed.

When ACTUAL exceeds RNP, the EICAS message NAV UNABLE RNP displays.

6 INDEX

Push – displays the INIT/REF INDEX page.

7 UPDATE ARM

Push –

- arms FMC position update function
- changes prompt to ARMED
- adds NOW prompts to right side of INERTIAL, GPS, and RADIO lines

Push a NOW prompt key to update FMC position to the selected source.

8 ACTUAL – INERTIAL

Displays actual navigation performance of the ADIRU.

9 ACTUAL – GPS

Displays actual navigation performance of the GPS.

10 ACTUAL – RADIO

Displays actual navigation performance of radio updating.

11 Radio Update Station(s)/Mode

Displays radio station identifiers.

Position update mode is indicated in the line title:

- DME DME
- VOR DME

12 Bearing/Distance (BRG/DIST) or Latitude/Longitude (LAT/LON)

Push – alternates position data format between bearing/distance or latitude/longitude.

The page illustration is shown in the latitude/longitude display format.

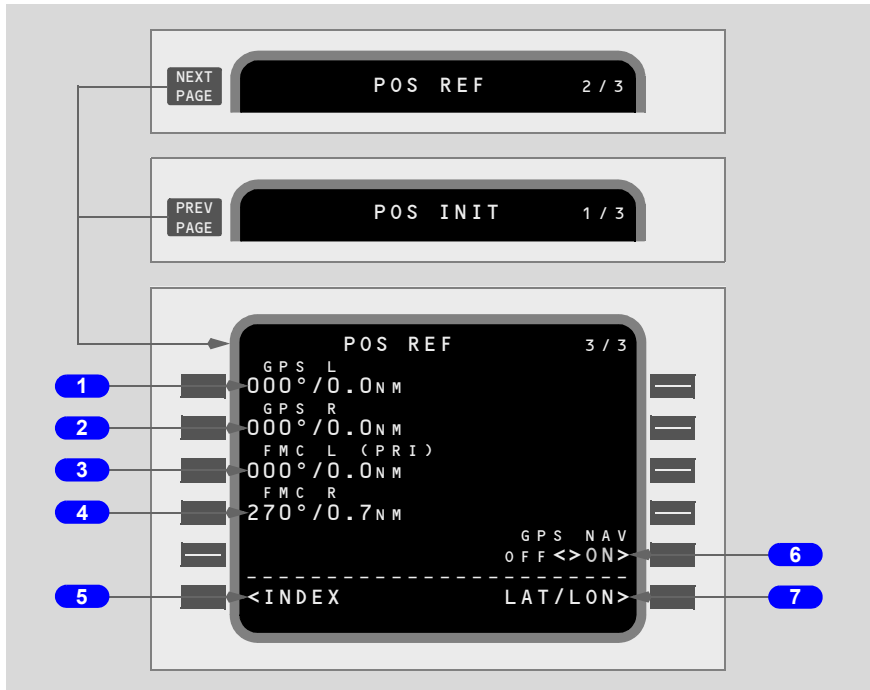
Latitude/longitude format displays are actual position.

Bearing/distance format displays the bearing and distance of other position sources relative to the FMC position.

Position Reference Page 3/3

On position reference page 3, the flight crew can observe the calculated positions from the left and right GPS receivers and the left and right FMC calculations. This page also allows the flight crew to enable or disable GPS position updates.

This page can display the bearing/distance or latitude/longitude format. The bearing/distance format displays bearing and distance of the position sources relative to the active FMC position on the POS REF 2/3 page. In the example, both the left and right GPS agree with the left FMC position.



1 GPS L

Displays the left GPS position.

2 GPS R

Displays the right GPS position.

3 FMC L

Displays the left FMC calculated position.

Primary (PRI) displays when the left FMC is active and the right FMC is inactive.

4 FMC R

Displays the right FMC calculated position.

PRI displays when the right FMC is active and the left FMC is inactive.

5 INDEX

Push – displays the INIT/REF INDEX page.

6 GPS NAV

Push – alternately selects GPS NAV ON (enabled) and OFF (disabled).

OFF – GPS position data is not available to the FMC. OFF displays in large green letters; ON displays in small white letters.

ON – GPS position data is available to the FMC. ON displays in large green letters; OFF displays in small white letters.

Note: When power is initially applied to the airplane or when engines are shut down, GPS NAV is set to ON.

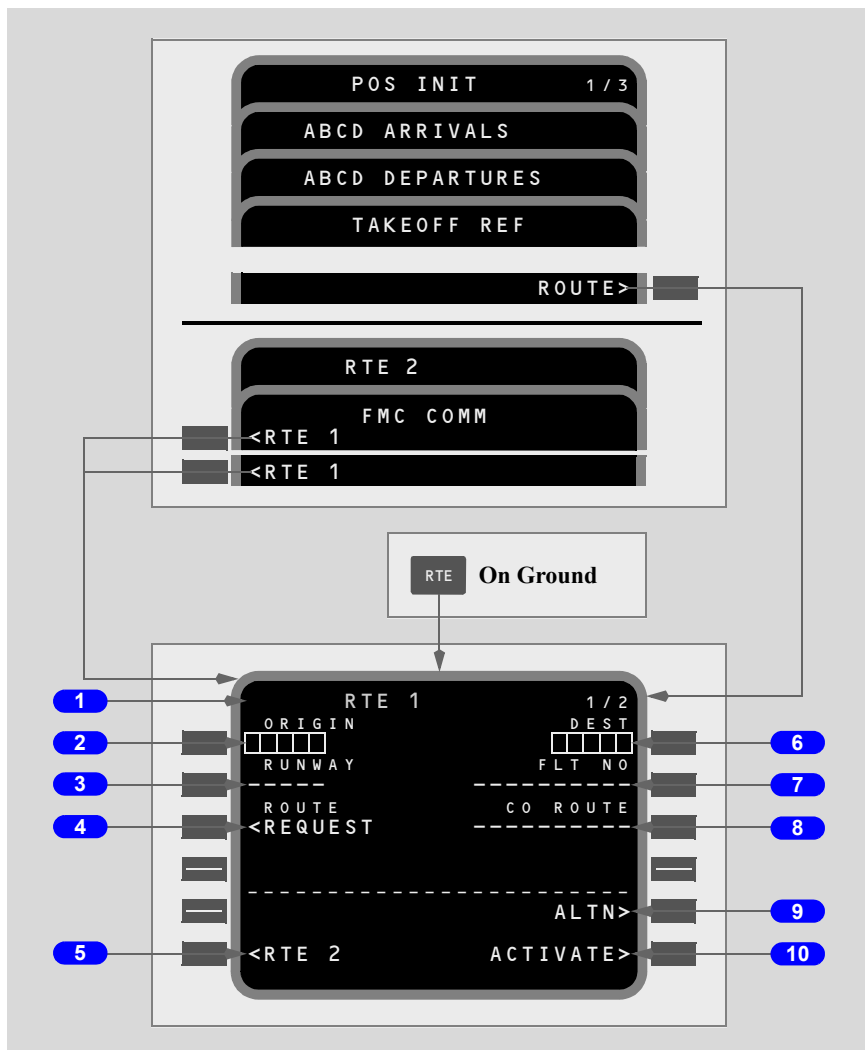
7 Latitude/Longitude (LAT/LON) or Bearing/Distance (BRG/DIST)

Push – alternately changes the display of position data on POS REF 2/3 and 3/3 to latitude/longitude format or bearing/distance format.

The page illustration is shown in the bearing/distance display mode.

Route Page 1/X

Two routes (RTE 1 and RTE 2) can be displayed in air traffic control format. Routes can be entered by the flight crew or uplinked through data link. All routes have two or more pages. The first route page displays origin and destination data. Subsequent route pages display route segments between waypoints or fixes. ROUTE 1 and ROUTE 2 allow management of alternate or future routes while leaving the active route unmodified. ROUTE 2 has an identical page structure as ROUTE 1. When RTE 2 is active, page display logic is the same as RTE 1.



1 Page Title

White when the route is active.

Cyan when the route is inactive or pending activation.

The white shaded word MOD precedes the page title when the route is modified and the change is not executed.

Multiple route pages are indicated by the page sequence number to the right of the title. The minimum number of route pages is 2.

2 ORIGIN

Entry:

- must be a valid ICAO identifier in the navigation database
- is made automatically when a company route is entered
- enables direct selection of departure and arrival procedures
- entry on the ground deletes route; in flight, entries are valid on the inactive route
- clears: wind levels on the WIND page, all existing company route identifiers, runways, destination airport, legs, and enroute procedures from an existing route

3 RUNWAY

Enter the applicable runway for the origin airport. Runway must be in the navigation database. Entry is optional.

New entries on an active route cause MOD to display in the route title.

Automatically entered when part of a company route.

Can be selected on the DEPARTURES page.

FMC deletes runway after the first waypoint is crossed.

4 ROUTE REQUEST

Line title displays DATA LINK when the data link status is NO COMM, VOICE, or FAIL.

Push – transmits a data link request for a flight plan route uplink. When a company route request identifier is displayed, it is propagated to the other route.

Flight crew can enter origin, destination, runway, flight number, company route name, or route definition to qualify request.

5 RTE 2, ERASE

RTE 2:

Push – displays the RTE 2 page 1/x.

Allows access to an inactive route for creation and modification or activation.

Inactive route modifications do not alter the active route.

Prompt changes to RTE 1 when RTE 2 is displayed.

ERASE:

Push - deletes all lateral and vertical mods to the displayed modified route.

Selection of <ERASE while a pending activation route is displayed returns the inactive route.

6 Destination (DEST)

Entry:

- must be a valid ICAO identifier in the navigation database
- is made automatically when a company route is entered
- enables selection of departure and arrival procedures

7 Flight Number (FLT NO)

Enter the company flight number.

Entry is optional for activation of the route.

Limited to 10 characters.

Flight crew entered or uplinked.

Flight number is included in the PROGRESS page title.

Flight number can be entered on multifunction COMM display ATC LOGON page.

Transponder transmits flight number to ATC when Eurocontrol-compliant transponder installed.

8 Company Route (CO ROUTE)

A company route can be called from the navigation database by entering the route identifier. The data supplied with a company route can include origin and destination airports, departure runway, SID and STAR, and the route of flight. All company route data is automatically entered when the route identifier is entered.

An entry is optional for activation of the route.

Enter a company route identifier.

Valid entry is any flight crew entered or uplinked company route name. If the name is not contained in the NAV database, the entry is allowed and the scratchpad message NOT IN DATABASE displays.

Entry of a new company route replaces the previous route.

In-flight entry is inhibited for the active route.

9 Alternate (ALTN)

Push – displays the ALTN page.

10 ACTIVATE

Push the ACTIVATE key to arm the route for execution as the active route. When the EXECUTE key is pushed, the route becomes the active route and the ACTIVATE prompt is replaced with the next required preflight page prompt.

Push – prepares the selected route for execution as the active route.

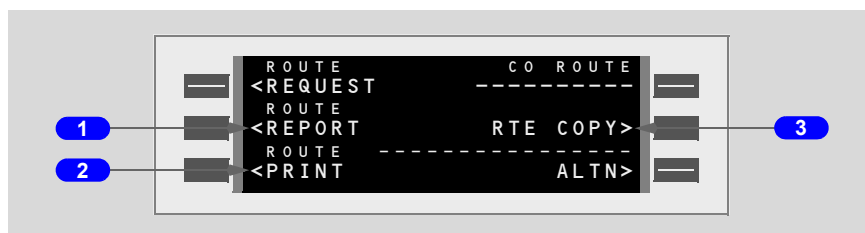
Activation of a route is required for completion of the preflight.

Displayed on inactive route pages.

After route activation, the ACTIVATE prompt is replaced by:

- PERF INIT, when the required performance data is incomplete, or
- TAKEOFF when the required performance data is complete

More Route Page Prompts for an Active Route



1 ROUTE REPORT

REPORT:

Push – transmits a flight plan downlink report.

LOAD:

Push – when the displayed route is inactive, it is replaced or modified by the flight plan uplink. When the displayed route is active, it is replaced or modified by the flight plan uplink and a modified route is created.

2 ROUTE PRINT

Push – sends the active route to the flight deck printer.

3 Route Copy (RTE COPY)

Push – copies the entire active route (RTE x) into the inactive route (RTE y).

Displayed only on the active route page.

Displays COMPLETE after the route is copied.

Route Page 2/X

The subsequent route pages 2/X through X/X, display route segments in air traffic control format. Route segments are defined as direct routing, airways, or procedures with start and end points such as waypoints, fixes, navaids, airports, or runways. More waypoints for each route segment are shown on the RTE LEGS page.



1 VIA

The VIA column displays the route segment to the waypoint or termination in the TO column. Enter the path which describes the route segment between the previous waypoint and the segment termination.

Enter an airway in the VIA column and boxes display in the TO column.

Valid entries can also include procedures or DIRECT. Procedures are usually entered through selections on DEPARTURES and ARRIVALS pages. DIRECT is usually entered as a result of entering a TO waypoint first.

Valid airways must:

- contain the fix entered in the TO waypoint, and
- contain the previous TO waypoint, or
- intersect the previous VIA route segment

Dashes change to DIRECT if the TO waypoint is entered first.

Dashes display for the first VIA beyond the end of the route.

Invalid VIA entries display the scratchpad INVALID ENTRY message.

Invalid VIA entries are:

- airways and company routes which do not contain the TO waypoint of the previous line
- airways that do not intersect the previous airway
- airways or company routes that are not in the navigation database

The start and end waypoints determine whether the entered airway is valid. The route segment must contain the waypoint entered in the TO position. The TO waypoint of the previous route segment must be the same as the start point of the next route segment or a route discontinuity is created between the segments.

Entry of a SID or transition enters the VIA and TO data for the route segments of the SID. A SID links to the next route segment when the final SID waypoint is part of the route segment.

When no SID is used, entering an airway on the first line of page 2 initiates an airway intercept from the runway heading and:

- replaces the airway with dashes in the first line VIA
- shows boxes in the first line TO waypoint
- moves the airway to line 2 after the TO waypoint is entered
- enters the first fix on the airway nearest to being abeam of the departure heading in the airway line TO waypoint

A route can contain segments formed by the intersection of two airways. Entering two intersecting airways in successive VIA lines without a TO waypoint causes the FMC to create an airway intersection waypoint to change from one segment to the next. The FMC created waypoint intersection (INTC) displays in the first airway segment TO waypoint.

LACRE3.VAMPS is an example of a SID selection made on the DEPARTURES page.

V2 and V336 are examples of airway entries.

APP TRANS is an example of a STAR selection made on the APPROACH page.

ILS32R is an example of an approach selection made on the APPROACH page.

2 TO

Enter the end point of the route segment specified by the VIA entry.

Entry of a waypoint in the TO column without first entering a VIA airway shows DIRECT in the VIA column.

Data input is mandatory when boxes are displayed.

Valid waypoint entries for a DIRECT route segment are any valid waypoint, fix, navaid, airport, or runway.

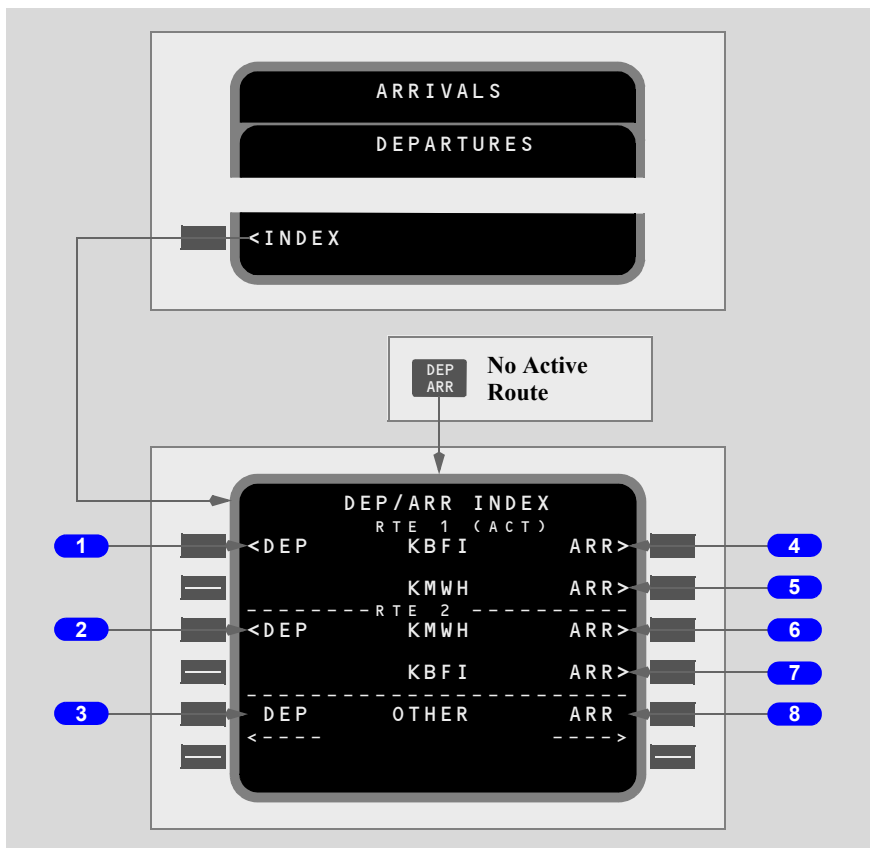
Valid waypoint entries for airways are waypoints or fixes on the airway.

Dashes display on the first TO waypoint after the end of the route.

Departure/Arrival Index Page

The departure and arrival index page is used to select the departure or arrival page for the origin and destination airports for each route. The index also allows reference to departure or arrival data for any other airport in the navigation database.

Departure and arrival prompts are available for the origin airport. Destination airports have only arrival prompts.



1 Departure (DEP) – Route 1

Push – displays the departure page for route 1 origin airport.

2 Departure (DEP) – Route 2

Push – displays the departure page for route 2 origin airport.

3 Departure (DEP) — Other

Displays the departure page for the airport entered into this line through the scratchpad.

DEP prompt for OTHER allows display of departure data about airports that are not an origin or destination. The data can be viewed but cannot be selected because the airport is not on the route.

4 Arrival (ARR) – Route 1 Origin

Push – displays the arrival page for route 1 origin airport. Origin airport arrivals selection is used during a turn-back situation.

5 Arrival (ARR) – Route 1 Destination

Push – displays the arrival page for route 1 destination airport.

6 Arrival (ARR) – Route 2 Origin

Push – displays the arrival page for route 2 origin airport. Origin airport arrivals selection is used during a turn-back situation.

7 Arrival (ARR) – Route 2 Destination

Push – displays the arrival page for route 2 destination airport.

8 Arrival (ARR) – Other

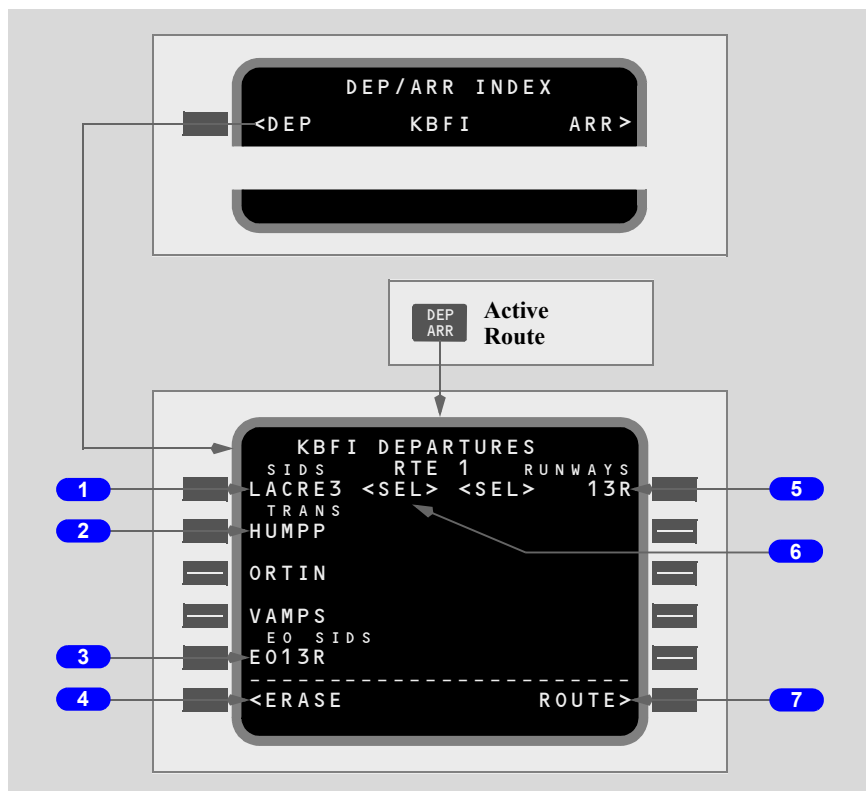
Displays the arrival page for the airport entered in this line through the scratchpad.

ARR prompt for OTHER allows display of arrival data about airports that are not an origin or destination. The data can be viewed but cannot be selected because the airport is not on the route.

Departures Page

The departures page is used to select the departure runway, SID, and transition for the route origin airport.

Pushing the DEP ARR function key displays the departures page for the inactive route when an inactive RTE or RTE LEGS page is displayed.



1 Standard Instrument Departures (SIDS)

Displays a list of SIDS for the airport.

Push –

- selects SID for use in the route
- other SIDS no longer display and transitions for the selected SID display
- runways for selected SID remain and others no longer display

2 Transitions (TRANS)

Displays transitions compatible with the selected SID.

Push –

- selects transition for entry in the route
- other transitions no longer display

3 Engine Out (EO) SIDS

Displays airline-defined single engine-out SIDs and all transitions for the selected runway. EO SID can be viewed before takeoff by line selecting and selecting the Legs page. EO SID automatically selected during takeoff if an engine-out detected prior to “flaps up”. The modification can be either executed or erased. If an EO SID does not exist, NONE displays.

PUSH - displays EO SID as the selected SID.

4 ERASE or INDEX

Erase displays when a route modification is pending. INDEX displays when no route modification is pending.

ERASE push – removes route modifications not executed and displays the original route.

INDEX push – displays the DEP/ARR INDEX page.

5 RUNWAYS

Displays a list of runways for the selected airport.

The runway selected on the RTE 1/X page displays as <SEL> or <ACT>.

Push –

- selects runway for use in the route. All other runways no longer display
- SIDs associated with selected runway remain, all others no longer display
- subsequent change of a runway deletes departure procedures previously selected

6 Selecting Options

Selecting an option displays <SEL> inboard of the option and creates a route modification. After executing the modification, <SEL> becomes <ACT>.

Executing a modification or leaving the page and returning displays all options and the <SEL> or <ACT> prompts.

7 ROUTE

Push – displays the related RTE page.

Navigation Radio Page

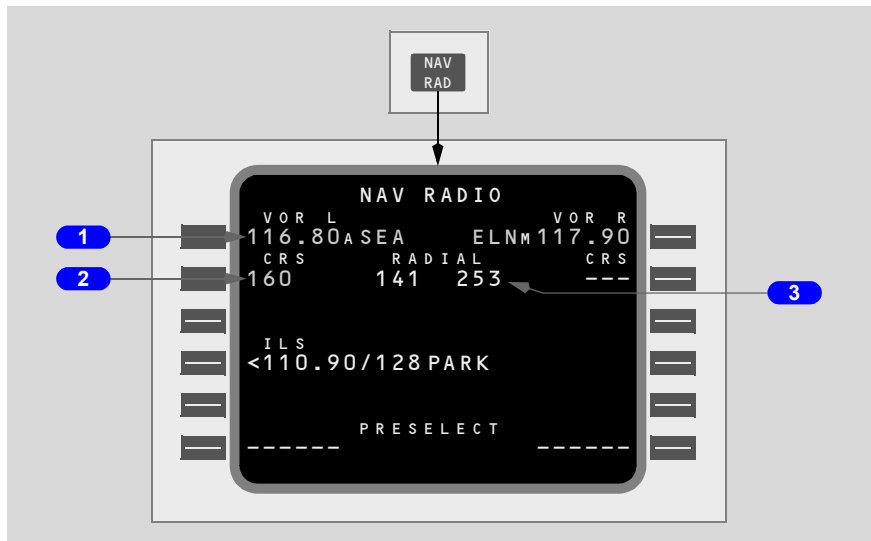
VOR and ILS navigation radios are normally autotuned by the FMC. ADF radios are manually tuned. The NAV RADIO page displays the VOR, ILS, and ADF radio status and allows manual control of these radios. Entering data on this page tunes the selected navigation radio. VOR courses can also be entered.

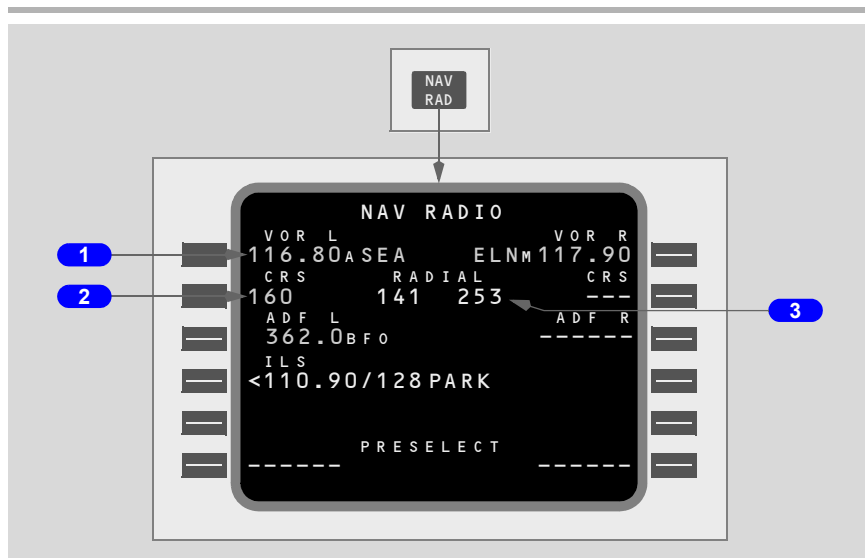
[ADF not installed on 200 Freighter; or, AIMS V14 delete option selected]

VOR and ILS navigation radios are normally autotuned by the FMC. The NAV RADIO page displays the VOR and ILS radio status and allows manual control of these radios. Entering data on this page tunes the selected navigation radio. VOR courses can also be entered.

VOR

[ADF not installed on 200 Freighter; or, AIMS V14 delete option selected]





1 VOR Frequency and Tune Status

The tuning status displays adjacent to left and right VOR frequencies. Entry of a frequency or identifier manual–tunes a VOR. FMC autotunes VORs for procedure flying and route operations. The FMC also tunes related DMEs. The tuning status displays are:

- P (procedure autotuning) – FMC selects navaids for approach or departure procedure guidance
- R (route autotuning) – FMC selects navaids on the active route. The navaid is the previous VOR or a downpath VOR within 250nm of aircraft position
- A (autotuning) – FMC selects a navaid for best position orientation
- M (manual) – VOR is manual–tuned. Manual–tuning takes priority over FMC autotuning. Deletion of a manual–tuned frequency returns system to autotuning

Valid entries:

- VOR or non–ILS DME identifier or VOR frequency (XXX.X or XXX.XX)
- VOR identifier or frequency/course; the course displays on the CRS line

The identifier and frequencies are green and tuning status is white.

Note: When magnetic variation at the airplane and VOR locations are significantly different, the ND VOR radial and ND POS green radial do not point directly to the VOR. This difference decreases as the airplane approaches the VOR.

2 CRS

Blank when in autotune.

Valid entry is a three-digit course. Data can be entered when dashes or a course are displayed.

With a VOR approach selected, sequencing an IAF/FAF causes the FMC to procedure autotune the VOR frequency. When the approach has a runway waypoint, the FMC selects the inbound course.

VOR course is green. Radial is white.

3 RADIAL

Displays radial from left and right VOR stations to the airplane.

ADF**1 ADF Frequency and Tune Status**

The tuning status displays adjacent to the left and right ADF frequencies. The tuning status displays are:

- ANT (antenna) – mode optimizes audio reception and removes ADF bearing data
- BFO (beat frequency oscillator) – mode for audio identification of stations transmitting unmodulated (CW) signals

Default tuning mode is ADF (no indication) giving both bearing data and audio.

Valid entries are XXX.X or XXXX.X.

Manual entry can be followed by A (ANT), B (BFO), or none, which defaults to the ADF mode.

Frequency is cyan and status is white.

ILS



[ADF not installed on 200 Freighter; or, AIMS V14 delete option selected]



1 ILS Frequency/Course and Tune Status

The tuning status displays adjacent to the ILS frequency and course. The ILS receivers operate in FMC autotune or manual-tuning modes. The FMC autotunes the ILS frequency and course. When the ILS is not necessary, the FMC sets the ILS to PARK. This removes the displays from the PFD.

Airplane position on the route determines the ILS operating mode. The operating mode displays are:

- PARK – the ILS is not being used and is not tuned
- XXX.XX/YYY PARK – the ILS is tuned for the selected approach but is not being used

- “A” indicates autotuning under FMC control for approach guidance
- “M” indicates the ILS is manually tuned

ILS autotuning is inhibited for ten minutes after takeoff and during manual-tuning. Autotuning and manual-tuning are inhibited when:

- the autopilot is engaged and either the localizer or glideslope is captured
- only the flight director is ON and either the localizer or glideslope is captured and the airplane is below 500 feet radio altitude
- on the ground with the localizer alive, the airplane heading within 45 degrees of the localizer front course and the ground speed is greater than 40 knots

Subsequent manual-tuning is enabled when:

- either TOGA switch is pushed
- the autopilot is disengaged and both flight directors are switched off
- the MCP approach switch is deselected when the airplane is above 1500 feet radio altitude

Valid entries:

- ILS frequency and front course (XXX.XX/YYY)
- front course, with a frequency and course already entered (/YYY)

2 PRESELECT

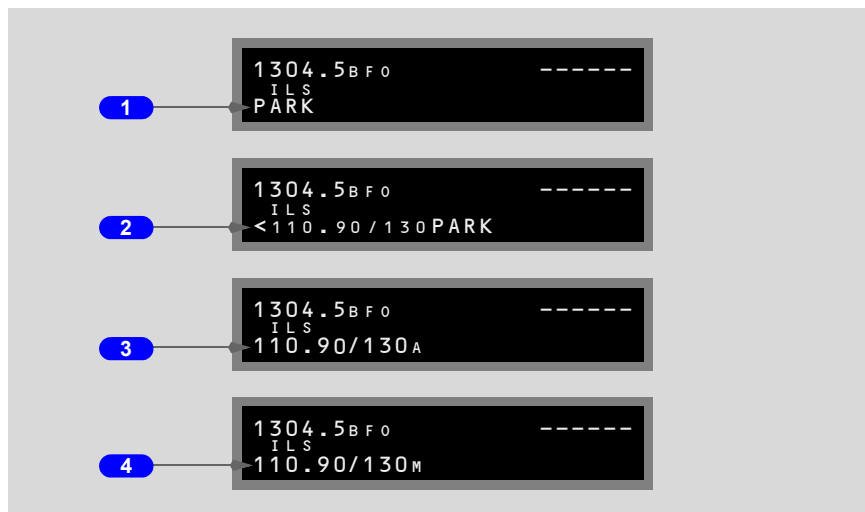
Any valid page data may be entered.

Put data into this line for later use. Data can be moved to the appropriate line when necessary.

ILS Tuning Status

The display initializes to PARK. When PARK displayed, the ILS is not tuned. The tuning status displays are:

- XXX.XX/YYY PARK – the ILS is autotuned for the selected approach but is not being used
- A (autotune) – ILS is autotuned for approach guidance
- M (manual) – ILS is manual-tuned



1 Park

PARK displays when:

- electrical power is first applied
- more than 200 NM from the T/D, or
- less than halfway to the destination

2 Tuning Status – Frequency, Course, and Park

ILS frequency, front course, and PARK display when an ILS, LOC, back course, LDA (localizer-type directional aid), or SDF (simplified directional facility) is selected, and:

- less than 200 NM from the T/D, or
- more than halfway to the destination, whichever represents the lesser distance to destination

Line selection manually tunes ILS.

3 Tuning Status – Autotune

ILS frequency, front course, and A display when an ILS, LOC, back course, LDA (localizer-type directional aid), or SDF (simplified directional facility) is selected, and:

- less than 50 NM from the T/D, or
- less than 150 NM from the runway threshold, or
- FMC is in descent mode

4 Tuning Status – Manual

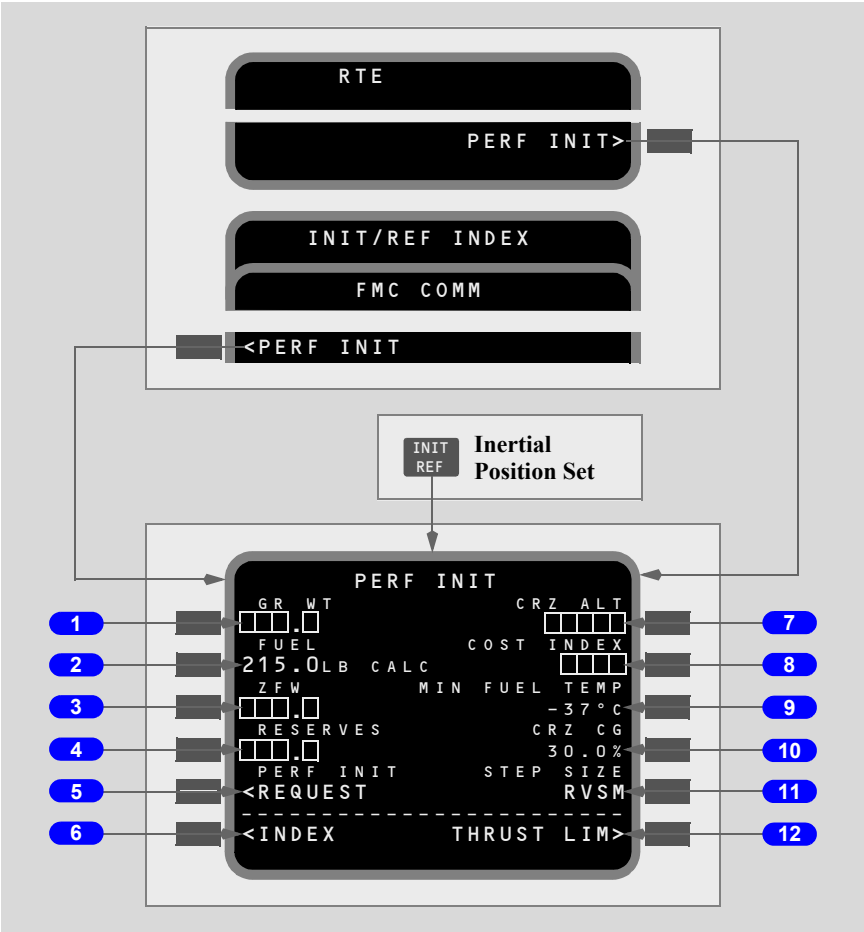
Receiver tuned manually and valid frequency/course display.

Preflight Pages – Part 2

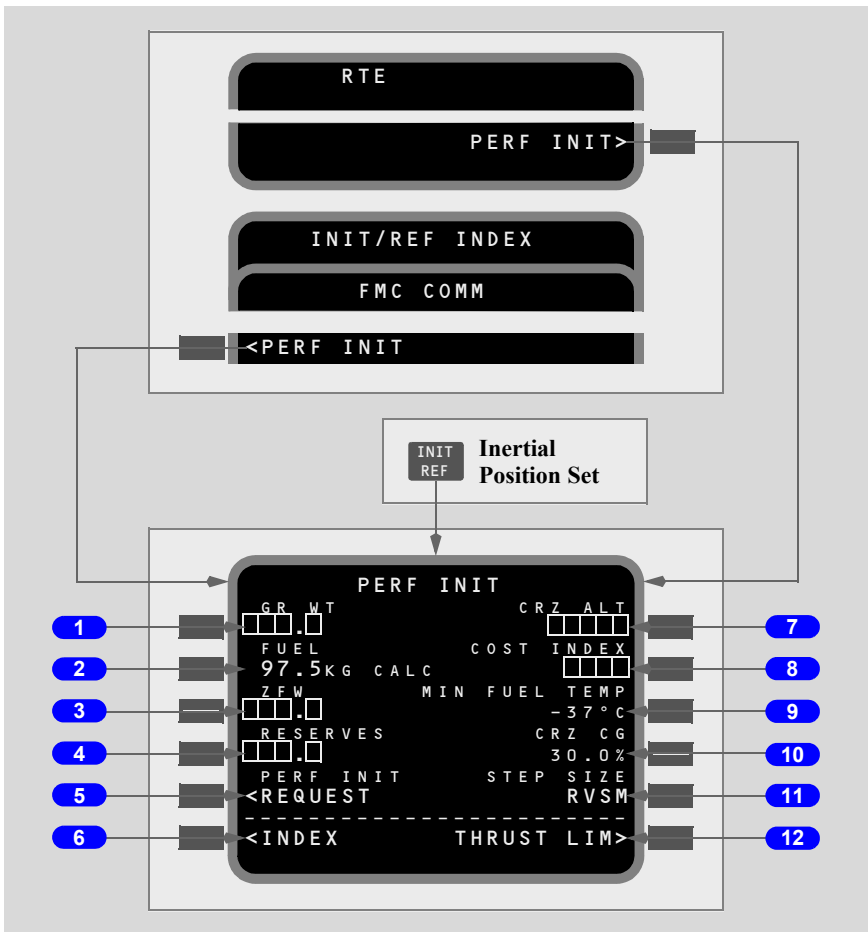
Performance Initialization Page

The performance initialization page allows the entry of airplane and route data to initialize performance calculations. This data is required for VNAV calculations.

[English Units]



[Metric Units]



1 Gross Weight (GR WT)

Airplane gross weight can be entered by the flight crew or calculated by the FMC after entry of zero fuel weight.

Valid entries are XXX or XXX.X.

Entering zero fuel weight first displays calculated gross weight.

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

2 FUEL

Fuel on board displays when the fuel totalizer calculations are valid. The source for the display is included in the line:

- SENSED – fuel quantity is from the totalizer. Manual entry is not possible
- CALC (calculated) – fuel quantity is from FMC calculations. Manual entry is possible
- MANUAL – fuel quantity has been manually entered. Manual entries blank totalizer on PROGRESS page 2/3

Valid entry is XXX or XXX.X.

Only manual entries can be deleted.

3 Zero Fuel Weight (ZFW)

Normally, ZFW is entered from the airplane dispatch papers and the FMC calculates the airplane gross weight.

Valid entry is XXX or XXX.X.

Calculated zero fuel weight displays when airplane gross weight is entered first and fuel on board is valid.

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

ZFW be manually entered or uplinked. When a performance uplink is pending, uplinked values (small font) display beside the entered values (large font).

4 RESERVES

Valid entry is XXX or XXX.X.

Can be manually entered or uplinked. When a performance uplink is pending, uplinked values (small font) display beside the entered values (large font).

5 Performance Initialization Request (PERF INIT REQUEST)

Push – transmits a data link request for performance data uplink.

Flight crew can fill in ZFW, CG, cruise altitude, reserves, cost index, or fuel temperature to qualify request.

6 INDEX

Push – displays the INIT/REF INDEX page.

7 Cruise Altitude (CRZ ALT)

Cruise altitude can be entered by the flight crew or from a company route or uplink.

Entry displays this cruise altitude on the CLB and CRZ pages.

8 COST INDEX

Cost index is used to calculate ECON climb, cruise, and descent speeds. Larger values increase ECON speeds. Entering zero results in maximum range airspeed and minimum trip fuel. Cost index can be entered by the flight crew or from a company route or uplink.

Valid entries are 0 to 9999.

9 Minimum Fuel Temperature (MIN FUEL TEMP)

Displays minimum fuel operating temperature (3 degrees C warmer than the fuel freeze temperature for a given fuel).

Default value from the AIRLINE POLICY page displays in small font and may not be deleted.

A PERF INIT uplink containing a minimum fuel temperature value pending ACCEPT/REJECT displays in small font. Accepting causes the value to display in large font.

Valid entries are -99 to -1 in degrees C.

Flight crew entered value displays in large font.

When actual fuel temperature reaches the displayed value, the EICAS advisory message FUEL TEMP LOW displays.

10 Cruise Center of Gravity (CRZ CG)

Used by FMC to compute maximum altitude and maneuver margin to buffet.

Displays default value selected in AMI. If the default CRZ CG value in AMI is blank, the CHECK AIRLINE POLICY message displays.

[\[777-200s/300s and FAA Rules\]](#)

Displays default value of 30.0% in small font and may not be deleted.

[\[777-200s and JAA Rules\]](#) or [\[777-200LRs and FAA\]](#) or [\[777Fs\]](#)

Displays default value of 14.0% in small font and may not be deleted.

[\[777-300s with JAA or -300ERs and not \(JAA and AIMS V14\)\]](#)

Displays default value of 7.5% in small font and may not be deleted.

Flight crew entered value displays in large font.

A PERF INIT uplink containing a cruise cg value pending ACCEPT/REJECT displays in small font. Accepting causes the value to display in large font.

[777-200s and FAA 300s and 777Fs]

Valid entry is 14.0 through 44.0.

[777-300s with JAA or -300ERs]

Valid entry is 7.5 through 44.0.

11 STEP SIZE

Displays the climb altitude increment used for planning the optimum climb profile.

Default value is: RVSM, ICAO, or 0 as selected in AMI.

Valid entries are:

- "0" to inhibit predicted step climbs, or
- altitudes from 1000 to 9900 in 100 foot increments, or
- "I" for ICAO, or
- "R" for RVSM

In-flight entries are inhibited. In-flight step size changes are made on the CRZ page.

For a non-zero entry, performance predictions are based on step climbs at optimum points. For a zero entry, performance predictions are based on a constant CRZ ALT.

12 Thrust Limit (THRUST LIM)

Push – shows the THRUST LIM page.

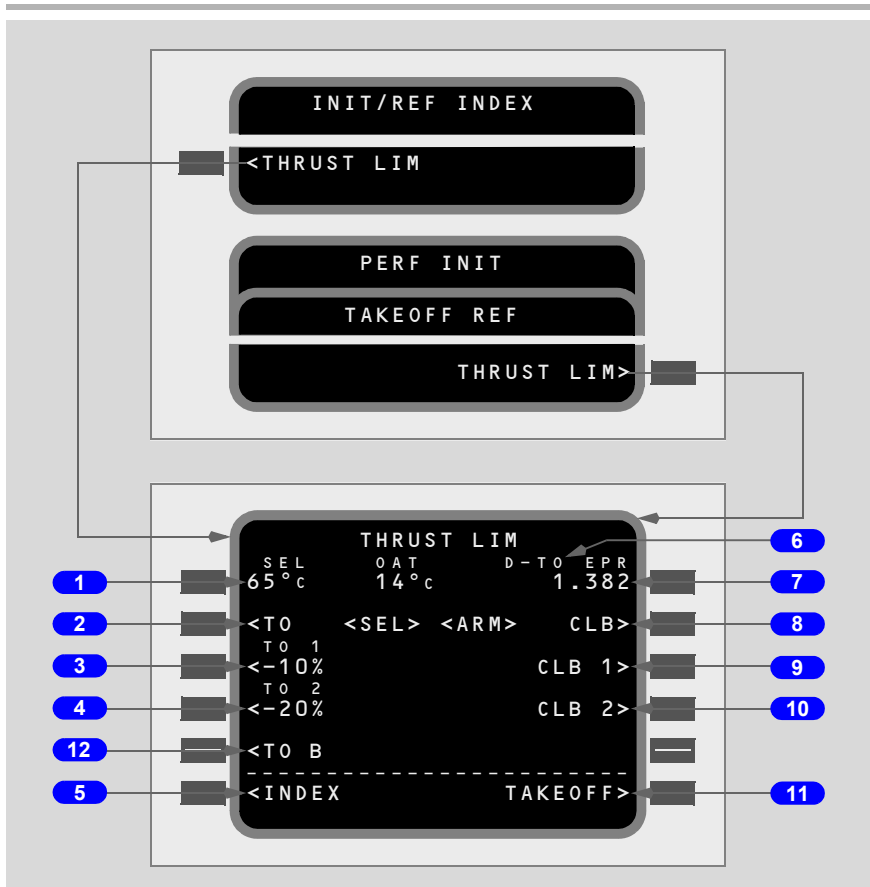
Thrust Limit Page

The thrust limit page allows selection and display of reference thrust for takeoff. Takeoff thrust derate by use of assumed temperature is also accomplished on this page.

Additional page data displays are:

- <SEL> – identifies the selected takeoff thrust reference mode
- <ARM> – identifies the armed climb thrust reference mode

The <ARM> prompt changes to <SEL> when the armed climb mode becomes active.



1 Assumed Temperature (SEL), APU-to-Pack, Outside Air Temperature (OAT)

Entry is allowed when the airplane is on the ground and dash prompts or large font temperature data is displayed.

Entry of an assumed temperature warmer than the OAT reduces takeoff thrust and displays D as part of the thrust reference mode.

Valid entries are 0 to 99 degrees Celsius (C) or 32 to 210 degrees Fahrenheit (F).

Entry of one, two, or three character temperature followed by “F” displays assumed temperature in degrees F; otherwise, assumed temperature displays in degrees C.

Uplinked temperatures display on both the THRUST LIM and TAKEOFF REF pages.

Flight crew entered or uplinked values replace previously displayed values.

Entry of a value after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

“SEL-APU” displays in the header when the APU is running. Selection of “APU” from the scratchpad displays “APU” in the data line in small font representing the ARMED state. Approximately one minute after the second engine start, “APU” displays in large font representing the ACTIVE state. Entry of an assumed temperature, shutting down the APU, selecting another TO rating, or deleting the entry; deletes the APU selection.

OAT displays outside air temperature in degrees C. When SEL temperature is in degrees F, the OAT converts to degrees F.

The assumed temperature thrust derate is not the same as TO 1 and TO 2 fixed thrust derates described below. If TO 1 or TO 2 is selected and an assumed temperature is then entered, thrust is further derated.

2 Takeoff (TO)

Push – selects full rated (TO) takeoff thrust limit.

Selection of a new rating after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

3 Takeoff 1 (TO 1)

Push – selects percentage derate (TO 1) for takeoff thrust limit.

Takeoff thrust derate can be entered by uplink.

TO 1 default thrust derate can be modified on the AIRLINE POLICY page.

Selecting TO 1 arms CLB 1.

4 Takeoff 2 (TO 2)

Push – selects percentage derate (TO 2) for takeoff thrust limit.

Takeoff thrust derate can be entered by uplink.

TO 2 default thrust derate can be modified on the AIRLINE POLICY page.

Selecting TO 2 arms CLB 2.

5 INDEX

Push – displays the INIT/REF INDEX page.

6 Thrust Reference Mode

Displays selected takeoff thrust mode.

"D-" displays when an assumed temperature derate is active.

[Option - Takeoff Bump]

The suffix B is added to the line title TO when Takeoff Bump is selected.

The prefix "A-" is added to the line title TO when APU-to-Pack takeoff is selected.

7 Takeoff EPR Limit

[Option – PW, RR Engines, With Takeoff Thrust Derates]

Displays the takeoff EPR calculated by the thrust management system. Displays N1 when the engines are operated in the alternate mode.

7 Takeoff N1 Limit

[Option – GE Engines, With Takeoff Thrust Derates]

Displays takeoff N1 calculated by the thrust management system.

8 Climb (CLB)

Push – selects the full rated (CLB) climb thrust limit.

Pushing a climb line select key overrides an automatic selection.

9 Climb 1 (CLB 1)

Push – selects a percentage derate (CLB 1) climb thrust limit.

Climb thrust derate can be entered by uplink.

10 Climb 2 (CLB 2)

Push – selects a percentage derate (CLB 2) climb thrust limit.

Climb thrust derate can be entered by uplink.

11 TAKEOFF

Push – displays the TAKEOFF REF page.

12 Takeoff Bump (TO B)

[Option – Takeoff Bump]

Push – selects additional takeoff thrust.

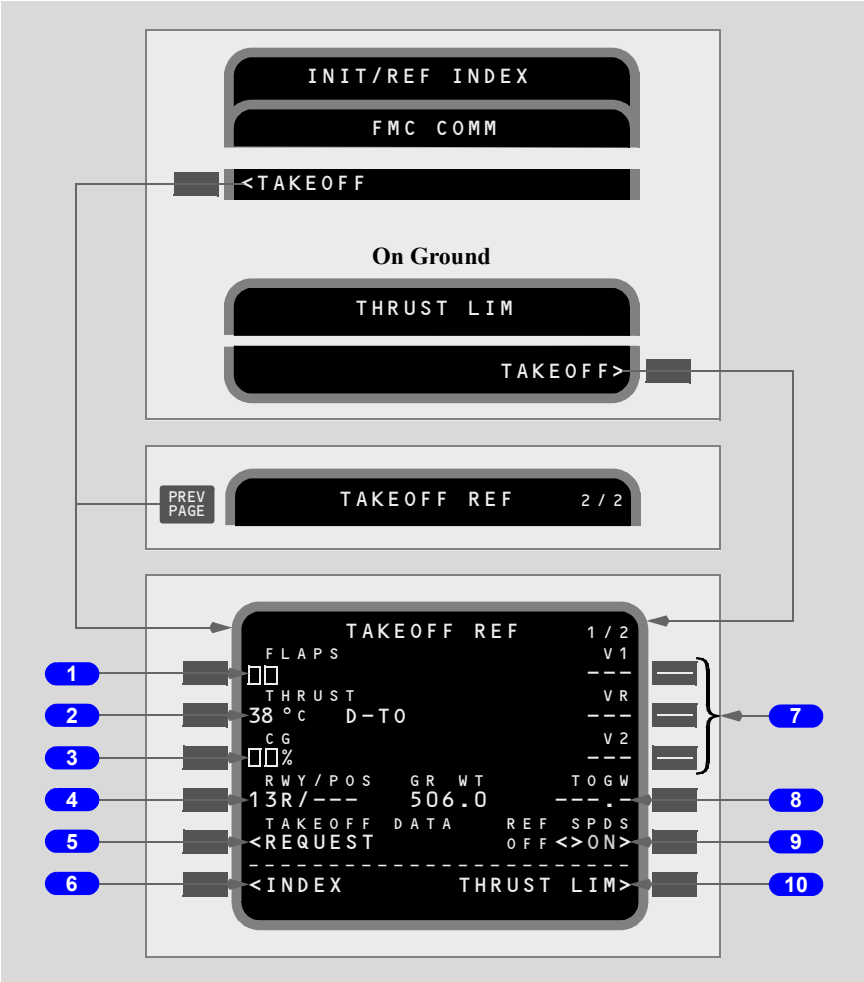
Selecting TO B arms CLB and inhibits assumed temperature derate.

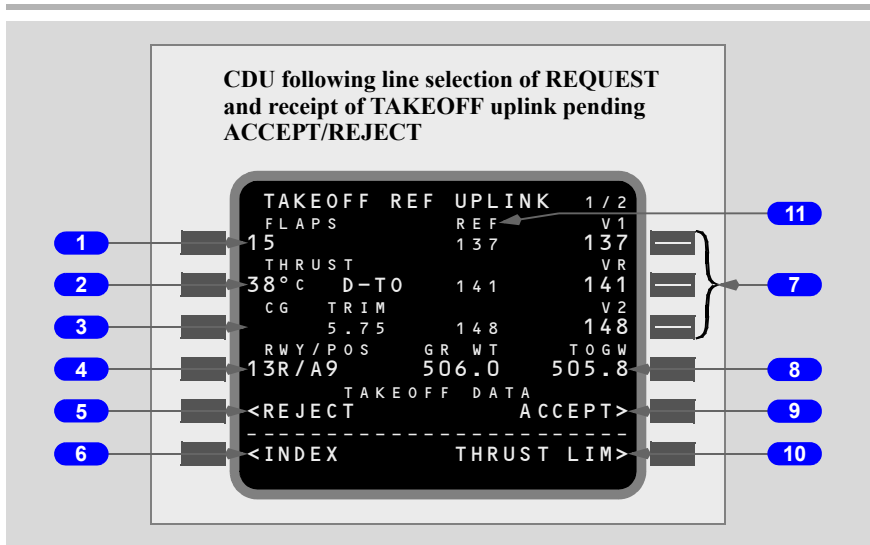
Refer to the Airplane Flight Manual (AFM) for the performance limitations and data required to use this feature.

Takeoff Reference Page 1/2

The takeoff reference page allows the flight crew to manage takeoff performance. Takeoff flap setting and V speeds are entered and verified. Thrust limits, takeoff position, and takeoff gross weight can be verified or changed. Preflight completion status is annunciated until complete.

Takeoff reference page entries finish the normal preflight. The takeoff flap setting must be entered and V speeds should be set before completion.





1 FLAPS

Displays takeoff flap setting. Valid entries are 5, 15, or 20.

Flight crew entry or uplink.

Entry of 5 when FLAPS 5 is the climb thrust reduction point displays the scratchpad message INVALID ENTRY.

Flap position is required for takeoff V speed calculations.

Entry of a value after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

2 THRUST

[Option: APU-to-PACK]

Displays takeoff thrust selected on THRUST LIM page, or flight crew or uplink entered assumed temperature for takeoff thrust derate calculations.

Entry is only allowed when the airplane is on the ground and dash prompts or large font temperature data is displayed.

Dashes display with TO B selected even though assumed temperature is not allowed. This indicates “APU” entry is allowed.

Entry of “APU” from scratchpad displays “A-XXX” with “XXX” being the takeoff thrust limit.

Valid entries are 0 to 99 degrees C or 32 to 210 degrees F.

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

3 Center of Gravity (CG) and TRIM

Valid entry is CG within the valid range.

After CG entered, the FMC:

- calculates and displays stabilizer takeoff setting to the right of the CG entry (trim display is in 0.25 unit increments)
- updates the takeoff green band displayed on stabilizer position indicators.

4 Runway/Position (RWY/POS)

Displays the selected takeoff runway, and TO/GA push distance from the runway threshold or runway intersection identification.

Displays the takeoff runway from the active RTE page if previously selected. Runway entry does not change runway entered on RTE or DEPARTURES page.

Flight crew may enter or uplink runway and intersection data.

Valid entry of a runway intersection is an alphanumeric up to three characters, preceded by a slash (/).

[Option - POS SHFT feet]

Valid position entry is a one or two numeric in the range 0-99. It must be followed by two zeros and preceded by a slash (preceding the entry with a “-” means a longer takeoff distance is available; for example, -0300 is 300 feet before the runway threshold).

[Option - POS SHFT meters]

Valid position entry is a one or two numeric in the range 0-30. It must be followed by two zeros and preceded by a slash (preceding the entry with a “-” means a longer takeoff distance is available; for example, -0300 is 300 meters before the runway threshold).

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

RWY/POS update inhibited when GPS is primary FMC navigation source.

5 TAKEOFF DATA REQUEST

REQUEST

Push – transmits a data link request for takeoff data uplink.

Flight crew can enter RWY, intersection or position shift, CG, TOGW, or OAT to qualify the request.

REJECT

Push – rejects the takeoff data uplink and returns the REQUEST prompt.

6 INDEX

Push – displays the INIT/REF INDEX page.

7 V Speeds (V1, VR, V2)

Displays dashes when:

- required information not entered
- performance calculations are inhibited
- ADIRU is not aligned

Calculated speeds display in small font.

Flight crew entry or uplink speeds replace calculated speeds. Manually entered and accepted uplinked speeds less than V1MIN, VRMIN, or V2MIN are indicated by display of "MINV1", "MINVR", or "MINV2" in the header line and the value of V1MIN, VRMIN, or V2MIN in the data line.

[Alt Fwd CG - Enabled basic on 300ER or 200LR or 777F; w/ AIMS V14]

Flight crew entry or uplink speeds replace calculated speeds. Manually entered and accepted uplink speeds equal or greater than V1MIN - 5 knots, VRMIN - 5 knots, or V2MIN - 5 knots are allowable. "MINV1", "MINVR", or "MINV2" do not display in the header line and speeds do not display on data lines.

The FMC Takeoff Speed Relative Value check ensures V1 is less than or equal to VR and VR is less than or equal to V2.

Entry of V speeds not passing the check results in the scratchpad message TAKEOFF SPEEDS DELETED.

Push –

- selects V1, VR, and V2 to be sent to using systems, or
- crew entered V speeds replace calculated speeds
- display changes to large font; REF and caret no longer display

If performance data changes:

- FMC replaces existing speeds with FMC calculated speeds in small font
- V speeds are removed from the PFD
- PFD speed tape message NO V SPD displays
- scratchpad message TAKEOFF SPEEDS DELETED displays

Note: After an engine is started, the FMC recalculates the takeoff speeds. Any combination of gross weight, OAT, or pressure altitude resulting in a takeoff speed change of two or more knots from the previously calculated speeds, causes the FMC to recalculate takeoff speeds.

8 Gross Weight (GR WT), Takeoff Gross Weight (TOGW)

GR WT displays airplane gross weight from the PERF INIT page.

TOGW – entry of airplane takeoff gross weight different from GR WT requests new takeoff data using data link.

Valid entry is any weight within the allowable airplane takeoff gross weight range. Flight crew entered value is downlinked when the REQUEST prompt is selected.

Entry of a value after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

Deletion of the TOGW value returns V speeds to small font; displays REF and caret.

A takeoff uplink displays the uplinked TOGW and associated V speeds.

9 Reference Speeds (REF SPDS), ACCEPT

REF SPDS:

Enables or disables display of the FMC calculated reference (V) speeds in the center column to the left of the V speed lines.

Push toggles between ON and OFF.

ON – displays FMC calculated takeoff speeds for comparison with the V speeds in the right column.

OFF – deletes speeds from the center column.

The active state, ON or OFF, displays in large green font; the inactive state displays in small white font.

ACCEPT:

Push – accepts the uplink takeoff data; all pending uplink values are treated as if entered by the flight crew.

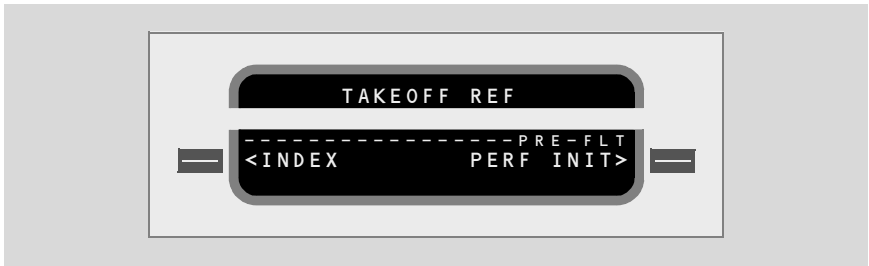
10 Thrust Limit (THRUST LIM)

Push – displays THRUST LIM page.

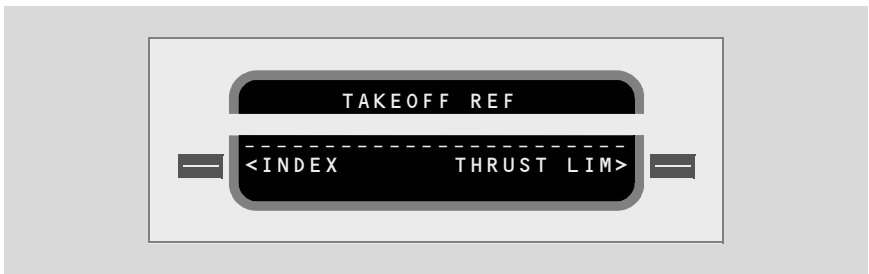
11 Reference (REF)

Displays the FMC calculated V speeds for comparison with flight crew entered or uplinked values. Display is enabled and inhibited by the REF SPDS prompt.

Preflight Status



If the required preflight entries are not complete, the words PRE-FLT display on the right side of the dashed line. Preflight pages requiring entries display below the dashed line as prompts.

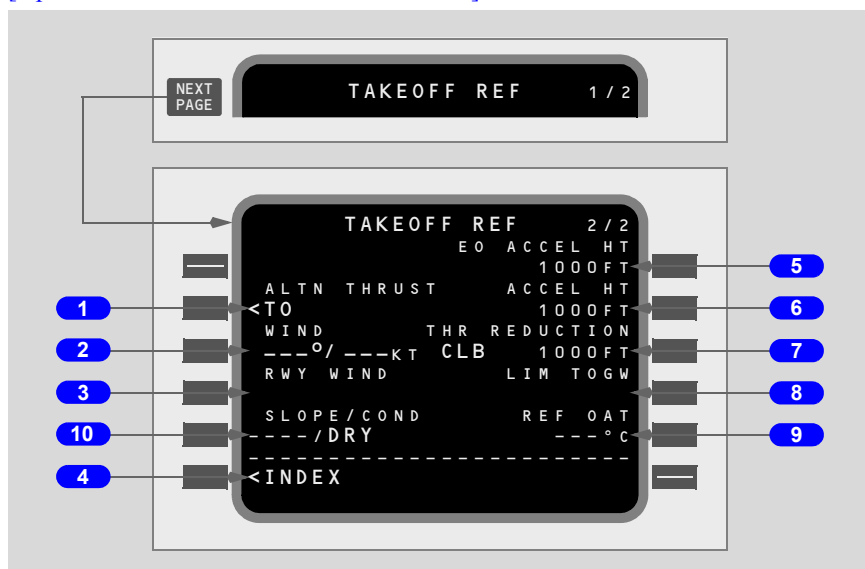


When preflight entries are complete, a dashed line displays below the takeoff reference page data. The THRUST LIM prompt displays below the dashed line.

Takeoff Reference Page 2/2

Note: Acceleration/thrust reduction heights are added to runway elevation causing acceleration/thrust reduction at the desired MSL altitude. For example, for a runway elevation of 980 feet, an entry of 2020 acceleration height causes acceleration at 3,000 feet MSL.

[Option - JAA Rules or Alt T/O SPD Rules]



1 Alternate Thrust (ALTN THRUST)

Display is active if a TAKEOFF REF uplink has been accepted which includes alternate thrust data.

Line title may display:

- ALTN THRUST
- ALTN THRUST/FLAPS.

Data may display temperature and:

- TO, TO/FLAPS
- TO 1, TO 1/FLAPS
- TO 2, TO 2/FLAPS
- yy° TO x (assumed temperature), yy° TO x/FLAPS.

Push (with data on the line) – selects alternate thrust or alternate thrust/flaps for takeoff resulting in:

- recomputation of V speeds
- the line title displays STD THRUST or STD THRUST/FLAPS
- the ACCEPT/REJECT prompt displays on the TAKEOFF REF page 1/2
- new takeoff data displays
- the EICAS •FMC message displays
- the scratchpad message TAKEOFF DATA LOADED displays.

2 WIND

Displays uplinked surface wind direction and speed.

Wind direction and speed can be entered by the flight crew or uplink.

Valid directions are from 0 to 360 degrees. (0 and 360 are shown as 000).

Valid speeds are from 0 to 250 knots.

Subsequent entries may be wind direction or speed only.

Entry of wind direction/speed results in calculation and display of RWY WIND.

Entry or uplink of a value after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

3 Runway Wind (RWY WIND)

Displays the calculated headwind/tailwind and crosswind components for the takeoff runway and surface wind.

Calculated values display in small font.

Speed displays in knots and:

- H for headwind
- T for tailwind
- R for right crosswind
- L for left crosswind.

Flight crew entry is limited to headwind/tailwind entry.

Valid flight crew entries are a two digit number followed by H or T.

Flight crew speed entry without a letter defaults to a headwind component.

A flight crew entry clears the WIND line.

4 INDEX

Push – displays the INIT/REF INDEX page.

5 Engine Out Acceleration Height (EO ACCEL HT)

Displays acceleration height for flap retraction with an engine out.

Default value is from the airline policy file.

Valid entry is a height from 400 to 9999 feet.

6 Acceleration Height (ACCEL HT)

Displays acceleration height in Height Above Airport (HAA) for flap retraction.

Default value is from the airline policy file.

Entry is optional. Valid entry is an HAA height from 400 to 9999 feet. The FMC adds runway elevation to entered HAA acceleration height causing acceleration at an MSL altitude. For example, for a runway elevation of 980 feet, an entry of 2020 acceleration height causes acceleration at 3,000 feet MSL.

7 Climb Thrust and Thrust Reduction (THR REDUCTION) Altitude

Displays armed climb thrust rating and HAA height for reduction from takeoff thrust to climb thrust. Default THR REDUCTION value is from the AIRLINE POLICY file.

Entry

- is optional for preflight completion
- is an HAA height from 400 to 9999 feet. The FMC adds runway elevation to entered HAA thrust reduction height causing thrust reduction at an MSL altitude. For example, for a runway elevation of 980 feet, an entry of 1020 thrust reduction height causes thrust reduction at 2,000 feet MSL, or
- 1 for flaps 1 and 5 for flaps 5 (entry of 5 when FLAPS 5 is specified as the takeoff flap setting displays the scratchpad message INVALID ENTRY).

8 Limit Takeoff Gross Weight (LIM TOGW)

Displays takeoff gross weight limit for the uplinked data. Manual entry not allowed.

Prefix ALT or STD is added to line title when alternate or standard takeoff data is pending.

9 Reference Outside Air Temperature (REF OAT)

Enter an outside air temperature:

- the FMC recalculates takeoff V speeds
- after takeoff speeds are selected, deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED
- for a downlink transmission.

Displays flight crew entered or uplinked data entry.

Valid entries are -54 to 99 degrees C, or -65 to 199 degrees F

10 Slope/Condition (SLOPE/COND)

[Option - Alt T/O SPD Rules, not V1_VR_V2_INH.]

Displays flight crew entered or uplinked data entry.

Valid runway slope entries are 1 or 2 digit numbers between 0.0 through 2.0 in percent gradient. Slope entries may be preceded by U (for uphill) or D (for downhill). Entries without a U or D are assumed to be uphill.

Valid runway condition is “D” or “DRY” for dry or “W” or “WET” for wet.

Entry of “S” or “WET SK-R” displays “WET SK-R” and FMC computes V1 for a skid resistant runway.

Entry of a value after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

Menu Page

[Typical]



1 FMC

Push – Connects FMC to CDU.

2 Satellite Communication/Cabin Interphone (SAT/CAB INT)

See Chapter 5, Communications.

3 EFIS Control (EFIS CTL)

See Chapter 10, Flight Instruments, Displays.

4 EFIS

When prompt is displayed, selection displays the EFIS CONTROL page.

5 Display Select Panel Control (DSP CTL)

See Chapter 10, Flight Instruments, Displays

6 Display (DSP)

When prompt is displayed, selection displays the DISPLAY MODES page.

7 Memory

Accessible only on the ground. For maintenance use only.

Flight Management, Navigation
FMC Takeoff and Climb**Chapter 11**
Section 41

Introduction

The FMC takeoff phase starts with the selection of takeoff/go-around (TO/GA). Preparation for this phase starts in the preflight phase and includes entry of the TAKEOFF REF page data.

The takeoff phase changes to the climb phase when the FMC commands climb thrust. The climb phase continues to the top of climb point, where the cruise phase starts.

During takeoff and climb, the specific page listed below is used to:

- TAKEOFF REF page – make last minute changes to the departure runway
- DEPARTURES page – make last minute changes to the SID
- CLIMB page – modify climb parameters and monitor airplane climb performance
- RTE X LEGS page – modify the route and monitor route progress
- PROGRESS page – monitor the overall progress of the flight
- THRUST LIM page – select alternate climb thrust limits
- DEP/ARR INDEX page – select an approach during a turn-back.

Takeoff

When changes are made to the departure runway and SID, the TAKEOFF REF and DEPARTURES pages must be modified to agree. The modified data are entered the same as during preflight.

With correct takeoff parameters, the FMC commands the selected takeoff thrust when the TO/GA switch is pushed. During the takeoff roll, the autothrottle commands the thrust and the FMC commands acceleration to between V2+15 and V2+25 knots, based on rate of rotation.

Usually, LNAV and VNAV are armed before takeoff. When armed before takeoff, LNAV activates at 50 feet radio altitude and commands roll to fly the active route leg. VNAV activates at 400 feet above runway elevation and commands pitch to fly the climb profile.

Climb

At acceleration height or the first movement of the flap handle during flap retraction, VNAV commands acceleration to a speed 5 knots below the flap placard speed for the existing flap setting. When flaps are retracted, VNAV commands the speed displayed on the SPD TRANS line.

At the climb thrust reduction point, the FMC commands a reduction to the armed climb thrust. Passing the transition altitude displayed on the SPD TRANS line, VNAV commands an acceleration to economy climb speed, which is maintained until entering the cruise phase. Waypoint speed constraints take priority, provided they are greater than VREF+80 or the transition speed.

During the climb, VNAV complies with the LEGS page waypoint altitude and speed constraints. A temporary level-off for a crossing altitude restriction is accomplished at the commanded speed. The commanded speed is magenta.

When the climb speed profile causes an anticipated violation of a waypoint altitude constraint, the FMC displays the CDU scratchpad message UNABLE NEXT ALTITUDE. A different speed profile that gives a steeper climb angle must be manually selected.

Altitude Intervention

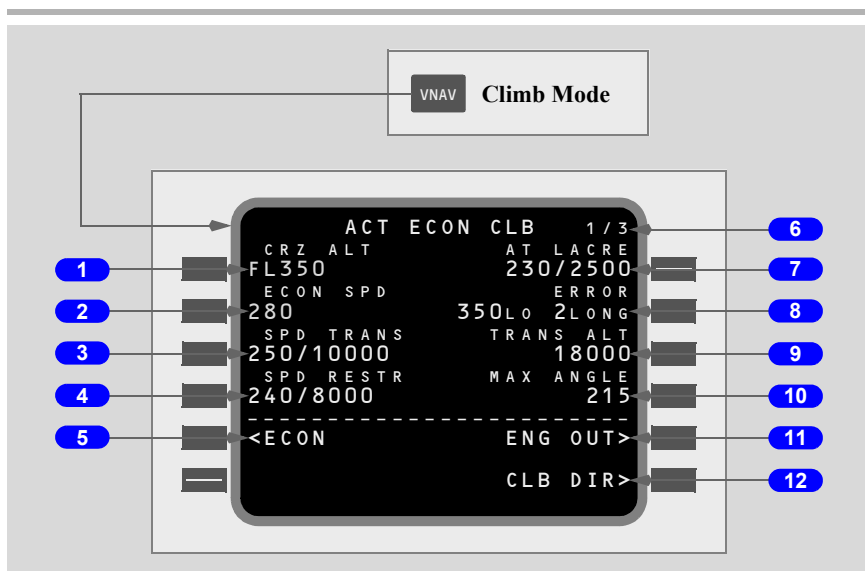
If an unplanned level-off is required, setting the altitude window to the required altitude causes the airplane to level at the set altitude. VNAV SPD changes to VNAV ALT. The climb can be continued by setting the altitude window to a higher altitude and pushing the altitude selector. If the altitude window is set to an altitude above other altitude constraints, each altitude constraint can be deleted by each push of the altitude selector. If cruise altitude is set in the altitude window, all waypoint altitude climb constraints to the T/C can be deleted by selection of the CLB DIR> prompt on the CLB page.

Climb Page

The climb page is used to evaluate, monitor, and modify the climb path. The data on the climb page comes from preflight entries made on the route and performance pages, and from the airline policy file.

The climb page is the first of the three pages selected with the VNAV function key. When the FMC changes to the cruise mode, the climb page data is blanked.

FMC climb can be economy, fixed speed, or engine out.



1 Cruise Altitude (CRZ ALT)

Displays cruise altitude entered on PERF INIT page.

Valid entries are: XXX, XXXX, XXXXX, or FLXXX. Altitude displays in feet or flight level depending on transition altitude.

The altitude can be changed by two methods:

- A new cruise altitude can be manually entered from the CDU at any time. The modified cruise altitude displays in shaded white until executed.
- A new cruise altitude can be entered from the MCP, if intermediate altitude constraints do not exist between the airplane altitude and the MCP altitude. Set cruise altitude in the altitude window and push the altitude selector. The cruise altitude changes without modification or execution.

2 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

ECON SPD:

- speed based on cost index in CAS or Mach
- used by FMC at altitudes above all waypoint speed constraints, speed restrictions, and speed transition altitudes.

Valid entries are CAS or Mach.

SEL SPD:

- displays when intermediate level off required below an existing speed constraint
- displays when flight crew enters speed

Valid entries are CAS or Mach.

The FMC commanded speed is magenta. Below CAS/Mach transition altitude, CAS is magenta and Mach is white. Above CAS/Mach transition altitude, Mach is magenta and CAS is white.

3 Speed Transition (SPD TRANS)

The speed transition line displays the transition speed/altitude from one of these sources:

- the navigation database value for the origin airport
- the greater of the transition speed associated with the origin airport or VREF+80 knots (example 250/10000)

Magenta when it is FMC command speed.

Not displayed above transition.

Can be deleted.

4 Speed Restriction (SPD RESTR)

Speed restrictions for an altitude less than the cruise altitude are manually entered on this line.

Dashes before entry by flight crew.

Valid entry is a CAS and altitude (example 240/8000).

An entry creates a modification. Entry is shaded white until executed; magenta when it is FMC command speed.

5 Economy (ECON)

Push – changes climb speed to ECON. Must be executed.

Prompt displays when the climb speed is not ECON.

6 Page Title

The page title displays the type of climb:

- ECON – speed based on a cost index
- LIM SPD – speed based on airplane configuration limiting speed
- MCP SPD – MCP speed intervention selected
- EO – engine out mode selected
- XXXKT – fixed CAS climb speed profile
- M.XXX – fixed Mach climb speed profile
- ACT – displays prefix when climb phase active.

Fixed climb speeds are for:

- takeoff/climb acceleration segment constraints
- waypoint speed constraints
- a speed constraint associated with an altitude
- a speed transition
- a flight crew selected speed (SEL SPD).

7 Waypoint Constraint (AT XXXXX)

Displays airspeed and/or altitude constraint at waypoint XXXXX.

Can also display HOLD AT XXXXX followed by a speed/altitude constraint.

FMC commands the slower of constraint speed or performance speed.

Constraints are entered on RTE LEGS page.

Delete here or on RTE LEGS page.

Blank if no constraint exists.

Magenta when it is FMC command speed or altitude.

8 ERROR at Waypoint

Displays altitude discrepancy and distance past waypoint where altitude will be reached.

Blank if no error exists.

9 Transition Altitude (TRANS ALT)

Transition altitude for origin airport contained in navigation database. FMC uses 18,000 feet if transition altitude is not available.

Manually change transition altitude here or on DESCENT FORECAST page.

Valid entries are XXX, XXXX, XXXXX, or FLXXX.

CDU altitude data change from altitudes to flight levels above the transition altitude.

10 Maximum Angle (MAX ANGLE)

Displays maximum angle of climb speed.

Entry not allowed.

11 Engine Out (ENG OUT)

Push (below speed transition or restriction altitude) –

- displays MOD EO CLB page
- deletes climb speed transition or restriction data

Push (below engine-out maximum altitude) – displays MOD EO CLB page.

Push (above engine-out maximum altitude) –

- displays MOD EO D/D page
- cruise altitude (1L) lowered to engine-out maximum altitude if that altitude is less than the active cruise altitude

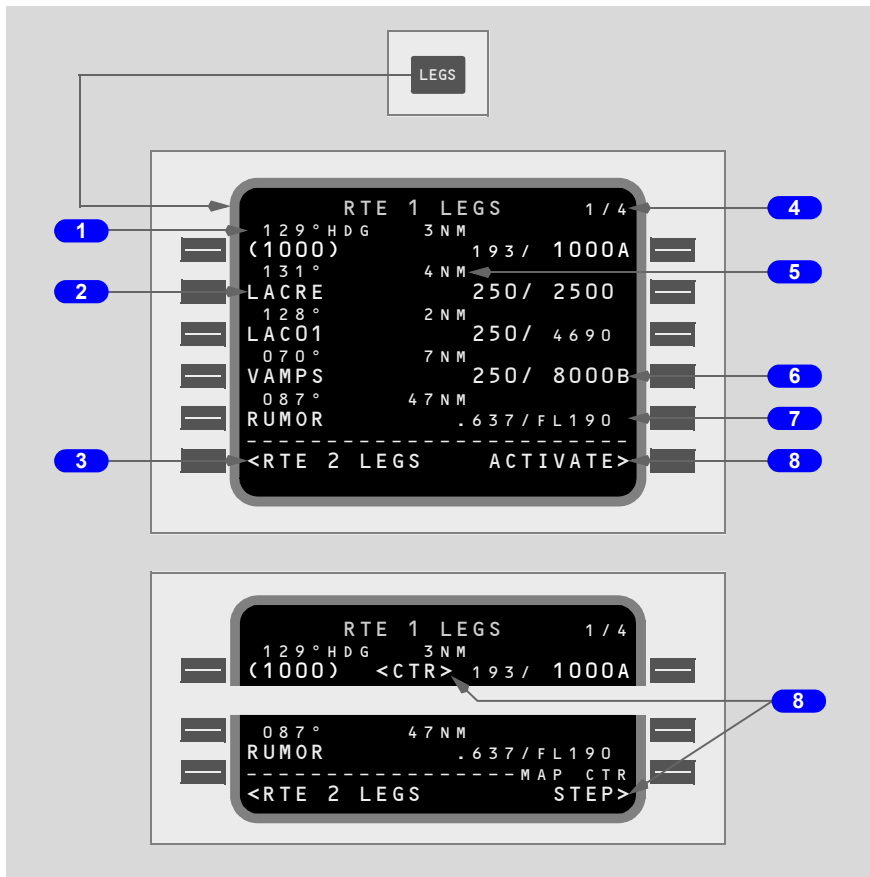
Shaded white until the modification executed. Upon execution, thrust reference limit becomes CON in all cases above.

12 Climb Direct (CLB DIR)

Displays when climb altitude constraint exists between current altitude and FMC cruise altitude.

Push – deletes all waypoint altitude constraints between the airplane altitude and the MCP altitude or FMC cruise altitude, whichever is lower. FMC cruise altitude is not affected.

RTE X LEGS Page



1 Leg Direction

Leg segment data in line title:

- courses – magnetic (xxx°) or true (xxx° T)
- arcs – arc radius in miles, ARC, turn direction (example: 12 ARC L)
- heading leg segments – xxx° HDG
- track leg segments – xxx° TRK
- special procedural instructions from database - HOLD AT, PROC TURN, or PROC HOLD (FMC exits hold when crossing the fix after entry).

Calculated great circle route leg directions may be different than chart values.

Dashes display for an undefined course.

2 Waypoint Identifier

Active leg is always the first line of the first active RTE X LEGS page.

Active waypoint is on active leg and is magenta. Modified waypoints are shaded white until executed.

All route waypoints display in flight sequence. Waypoints on an airway are included on the route legs page.

Waypoints can be modified. Examples:

- add waypoints
- delete waypoints
- change waypoint sequence
- connect route discontinuities.

Displays the waypoint by name or condition.

Boxes display for route discontinuities.

Dashes display after the end of the route.

3 Route 2 Legs (RTE 2 LEGS)

Push –

- displays the RTE 2 LEGS
- when RTE 2 LEGS page displayed, prompt changes to RTE 1 LEGS.

4 Page Title

Title format displays route status:

- RTE X LEGS (cyan) – inactive route
- ACT RTE X LEGS (white) – active route
- MOD (shaded white) RTE X LEGS (white) – modified active route.

5 Distance to Waypoint

Distance (decreasing) from airplane to active waypoint or from waypoint to waypoint. Blank for some leg types (e.g. HDG or VECTORS).

6 Waypoint Speed/Altitude Constraints

Waypoint speed or altitude constraints display in large font.

Manual entry allowed in climb or descent phase. Entered by FMC when constraints are part of a procedure.

Magenta when it is an FMC commanded speed/altitude. Airspeed constraint may be magenta in one line with magenta altitude in another line.

Speed constraint is assumed to be at or below the displayed speed.

Valid entries are:

- speed entry can be airspeed or Mach
- altitude entry can be thousands of feet or flight level (19000, FL190)
- XXX/XXXXX – airspeed/altitude entered simultaneously
- XXX, XXXX, XXXXX or /XXX, /XXXX, /XXXXX– altitude only.
- enter FL 190 or 19,000 feet as 190 or 19000. Enter FL090 or 9,000 feet as 090 or 9000. Enter 900 feet as 009 or 0900. Enter 90 feet as 0090.

Altitude constraint suffixes:

- blank – cross at altitude
- A – cross at or above altitude
- B – cross at or below altitude
- both – altitude block. If constraint is to cross between two altitudes when climbing, enter lower altitude followed by “A”; then, enter higher altitude followed by “B”. Example: 220A240B. Reverse the order for descent.
- S – planned step climb (refer to Flight Management, Navigation, Cruise).

7 Waypoint Speed/Altitude Predictions

Waypoint speed and altitude predictions display in small font.

Dashes display in predicted descent region prior to descent path calculation.

Descent path calculation requires an altitude constraint below cruise altitude.

Manual entry allowed in climb or descent phase.

8 ACTIVATE, Route (RTE) DATA

Push –

- ACTIVATE – activates inactive flight plan; displays RTE DATA prompt
- RTE DATA – displays route data page
- MAP CTR STEP (map center step)– changes centered waypoint on ND.
<CTR> is adjacent centered waypoint on the RTE LEGS page.

ACTIVATE prompt displays when RTE and RTE LEGS flight plan is inactive.

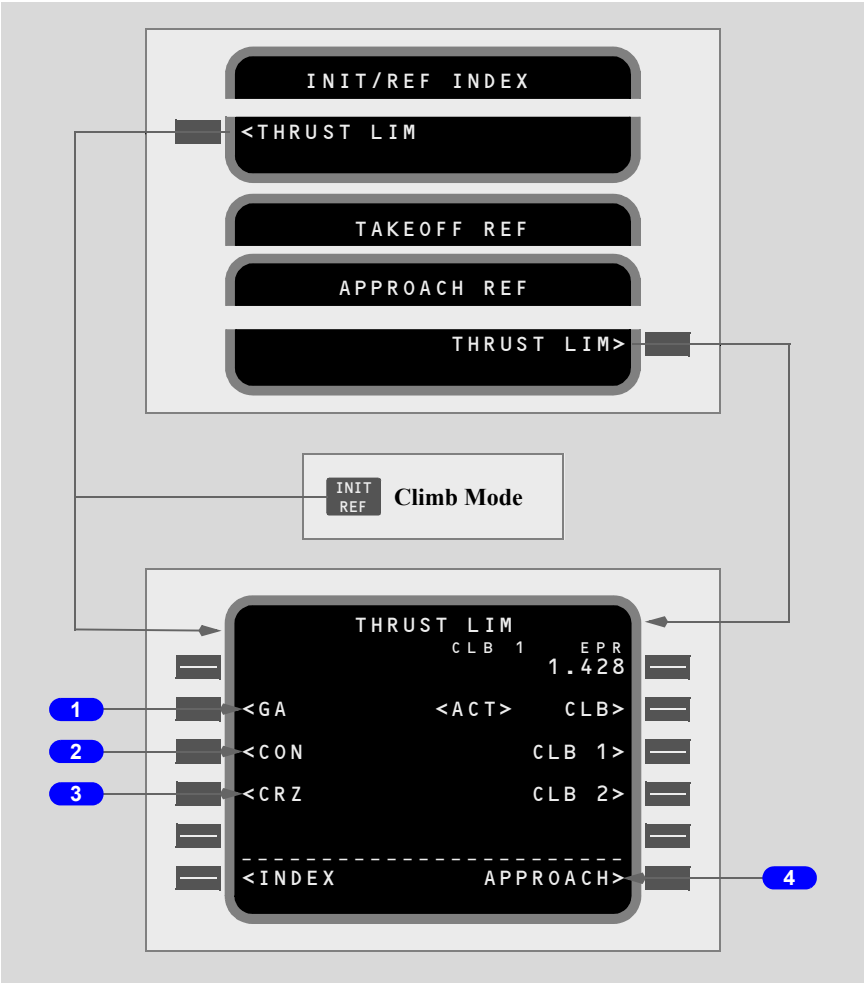
RTE DATA displays after ACTIVATE prompt pushed.

MAP CTR STEP prompt displays when the EFIS control panel ND mode selector is in PLAN position.

Thrust Limit Page

Thrust limits are selected on the thrust limit page. In flight, this display replaces the takeoff thrust limits with applicable thrust limits for climb. The selected limits display here and on the EICAS Display.

Fixed thrust derates can be selected for climb. Go-around, continuous and cruise thrust limits are available also.



1 Go-Around (GA)

Push – selects go-around thrust limit.

2 Continuous (CON)

Push – selects maximum continuous thrust limit.

3 Cruise (CRZ)

Push – selects cruise thrust limit.

4 APPROACH

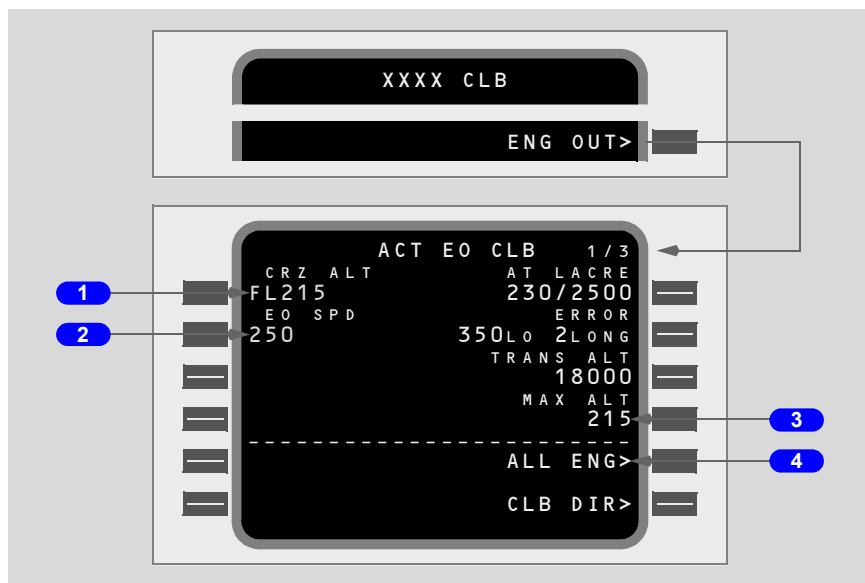
Push – displays APPROACH REF page.

Engine Out Climb

Engine out (EO) VNAV climb guidance is available on the EO CLB page. The EO CLB page must be selected and executed by the flight crew. Engine out data is available with both engines operating. The engine out climb phase changes to the engine out cruise phase at the top of climb.

EO CLB Page

The modified page displays engine out performance limitations. Manual entries are allowed. After execution, VNAV gives EO guidance in the climb and reference thrust limit changes to CON.



1 Cruise Altitude (CRZ ALT)

Displays cruise altitude if less than MAX ALT.

Displays MAX ALT if less than cruise altitude.

Manual entry is allowed.

2 Engine Out Speed (EO SPD)

Displays engine out climb speed.

Valid entry is xxx for CAS.

Valid entry is 0.xxx for Mach. Trailing zeros can be omitted.

A manual entry may cause MAX ALT to change.

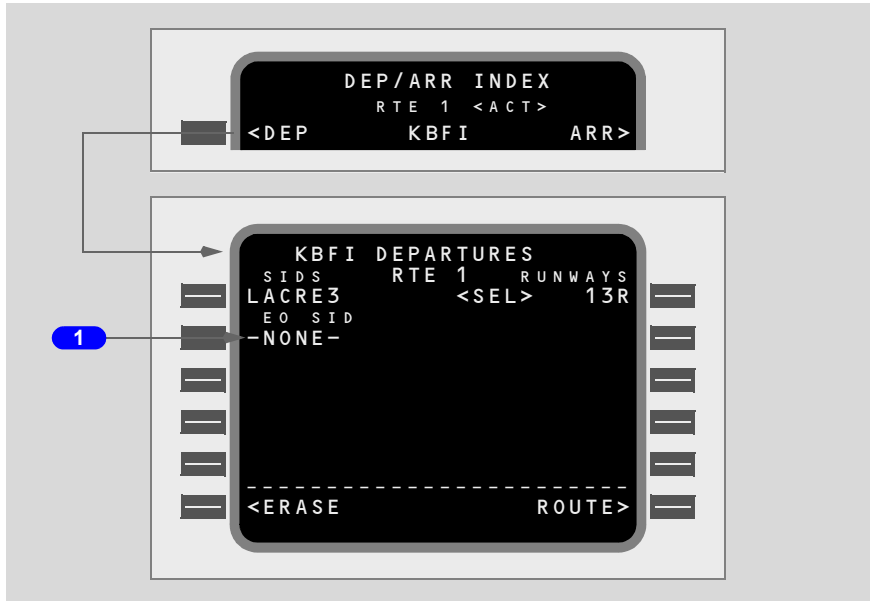
3 Maximum Altitude (MAX ALT)

Displays lower of maximum altitude at engine out climb speed or cruise speed.

Entry not allowed.

4 ALL ENG

Push – modifies page to display all engine (ALL ENG) performance data.

Engine Out Departure**1 Engine Out Standard Instrument Departure (EO SID)**

Engine out SIDs can be created by the airline for specific runways.

The FMC puts the EO SID into the route as a modification if:

- an engine failure is sensed
- flaps extended
- and the navigation database has an EO SID for the departure runway.

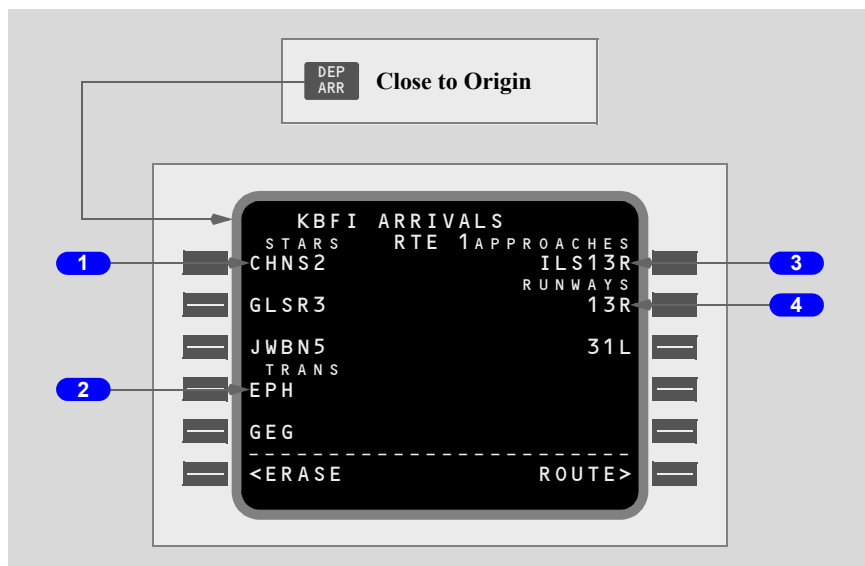
The modification can be executed or erased.

Air Turnback

Arrivals Page

During a turn-back situation, the flight crew requires quick access to the arrivals data for the origin airport. The arrivals page allows access without changing the destination on the route page.

During climb, less than 400 miles from the origin, and while nearer to the origin than the destination, push the DEP ARR function key to show the ARRIVALS page for the origin airport.



1 STARS

Displays STARS for origin airport.

2 Transitions (TRANS)

Displays transitions for origin airport.

3 APPROACHES

Displays approaches for origin airport.

4 RUNWAYS

Displays runways for origin airport.

Flight Management, Navigation
FMC Cruise**Chapter 11**
Section 42

Introduction

The cruise phase starts at the top of climb.

During cruise, the primary FMC pages are:

- RTE X LEGS
- CRZ
- PROGRESS.

The RTE LEGS pages are used to modify the route. The CRZ pages display VNAV related data. The PROGRESS pages display flight progress data. During cruise, the specific page listed below is used to:

- POS REF page – verify the FMC position
- RTE DATA page – display progress data for each waypoint on the RTE LEGS page
- WINDS page – enter forecast wind and temperature
- REF NAV DATA page – display data about waypoints, nav aids, airports, or runways, and can be used to inhibit nav aids
- RTE X page – use to select a route offset
- FIX INFO page – display data about waypoints. Page data can be transferred to other pages to create new waypoints and fixes
- SELECT DESIRED WAYPOINT page – shows a list of duplicate waypoints from the navigation database. The flight crew selects the correct waypoint from the list
- POS REPORT page – display data for a position report.

The CLB page changes to CRZ at the top of climb. The CRZ CLB and CRZ DES pages change to CRZ at the new cruise altitude. The CRZ page changes to DES at top of descent.

LNAV Modifications

This section describes typical techniques to modify the route. The modifications include:

- add and delete waypoints
- change waypoint's sequence
- remove discontinuities
- intercept a course.

RTE LEGS Page Modifications

When modifications are made to a RTE LEGS page, several prompt or identifying features help the flight crew make the modifications, such as:

- ERASE
- INTC CRS TO
- INTC CRS FROM.

Modified entries display in shaded white.

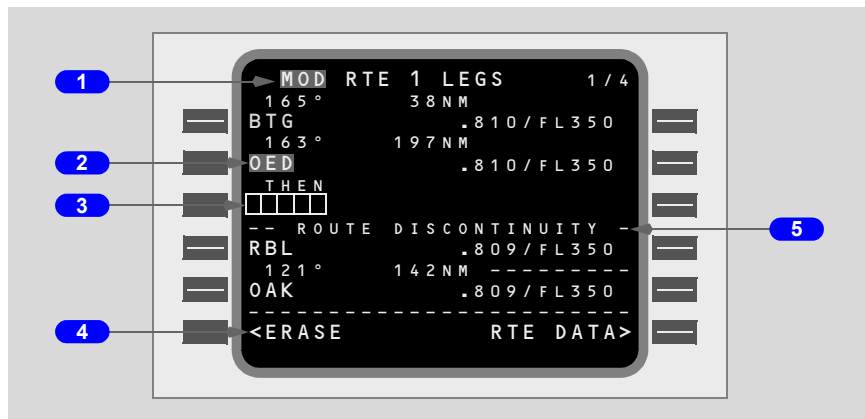
Add Waypoints

Waypoints can be added to the route at any point. Added waypoints are followed by route discontinuities.

First, enter the waypoint name in the scratchpad.

Second, locate the desired line in the flight plan and push the adjacent line select key. The scratchpad waypoint name is put into the selected line. The entered waypoint is connected to the waypoint above it via a direct route. A route discontinuity follows the waypoint.

For example, OED is typed into the scratchpad. Push line select key 2L to put OED into line 2. The FMC assumes BTG direct OED. RBL and the rest of the flight plan follow the route discontinuity.



1 Page Title

MOD (shaded white) – replaces ACT when modification in progress.

ACT (white) – replaces MOD when ERASE selected or execute key pushed.

2 Modified Waypoint

Waypoint name is shaded white until executed.

OED waypoint entered into the route after BTG. Modification creates a route discontinuity because OED was not in active route. The FMC now requires routing beyond OED.

3 Discontinuity Waypoint

Discontinuity is removed when applicable waypoint is entered in boxes.

4 ERASE

Push – removes all modifications and shows active data.

Displays when the FMC contains modified data.

Removed when selected or modifications executed.

5 ROUTE DISCONTINUITY

Line title separates route segments when there is a discontinuity.

Note: Performance predictions to destination on the PROGRESS page are calculated assuming the route of flight is direct between waypoints on either side of a route discontinuity.

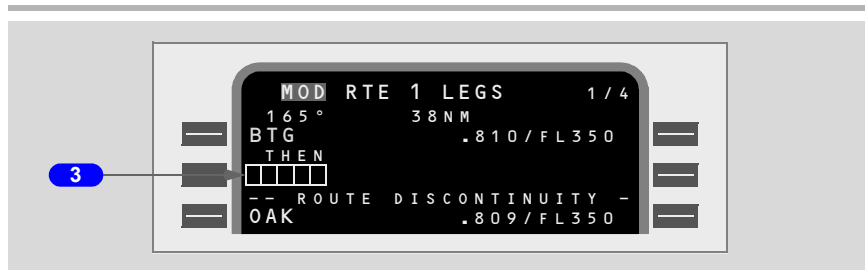
Delete Waypoints

Use the RTE LEGS page to remove waypoints from the route. The active waypoint can not be deleted. Two methods to remove a waypoint are:

- delete the waypoint with the DELETE function key
- change the waypoint's sequence.

The data in the route before and after the deleted waypoint does not change. A discontinuity is put in the route when the DELETE function key is used to remove a waypoint.





1 Active Route

The active route shows RBL followed by OAK and AVE.

2 DELETE Entry

Pushing the DEL function key arms the delete function and selects DELETE to the scratchpad.

3 Route Discontinuity

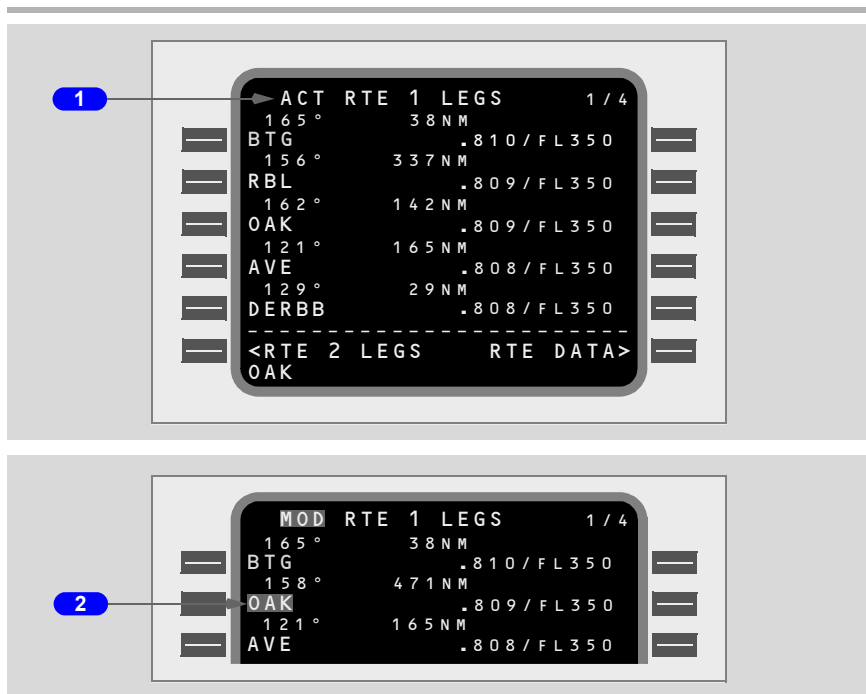
With DELETE in the scratchpad, pushing the line select key for RBL deletes the waypoint. Boxes replace RBL and a route discontinuity displays.

Change Waypoint Sequence

Waypoints moved from one position in the flight plan to another do not cause route discontinuities.

The waypoint may be typed in the scratchpad or copied from the flight plan. To copy a waypoint from the flight plan, find the applicable waypoint on one of the RTE LEGS pages. Push the line select key adjacent to the waypoint.

The example below shows the flight plan being modified to fly from BTG direct OAK. Push the line select key adjacent to OAK to put OAK in the scratchpad. Push the line select key adjacent to RBL. RBL is removed from the flight plan and the routing is direct from BTG to OAK to AVE. The modification does not cause a route discontinuity. Several waypoints can be removed from the flight plan at a time with this method.



1 Active Route

The active route shows RBL followed by OAK and AVE. The clearance is to fly from BTG direct OAK. The OAK waypoint is selected to the scratchpad.

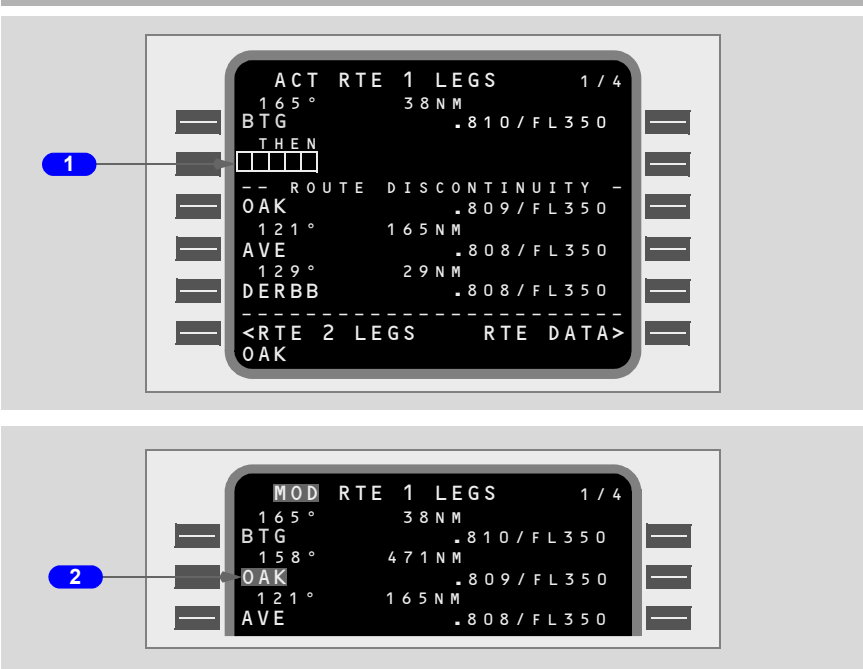
2 Change OAK's Sequence

OAK is selected to the waypoint after BTG. RBL is removed with no discontinuity.

Remove Discontinuities

A discontinuity exists when two waypoints are not connected by a route segment. Connect a route segment after the discontinuity to the route segment before the discontinuity to remove the discontinuity.

Copy the subsequent waypoint from the route into the scratchpad and enter it into the discontinuity, just as when adding a waypoint.



1 Route Discontinuity

The active route has a discontinuity after BTG. The example shows how to fly direct from BTG to OAK. Copy OAK to the scratchpad. Any subsequent waypoint in the route can be selected to the scratchpad to remove the discontinuity.

2 Continuous Route

Select OAK to the boxes to remove the discontinuity.

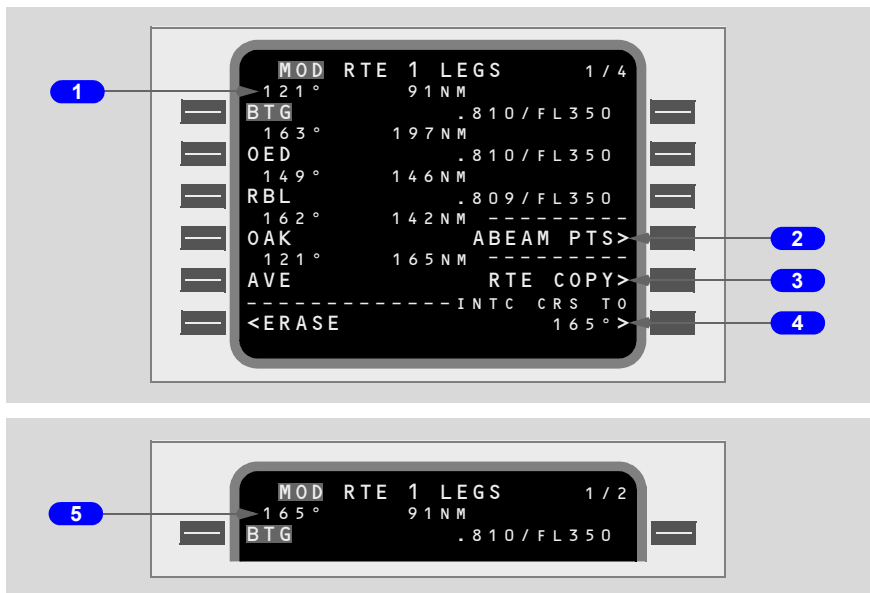
Entering a waypoint in the boxes which does not already exist on the route moves the discontinuity one waypoint further down the route.

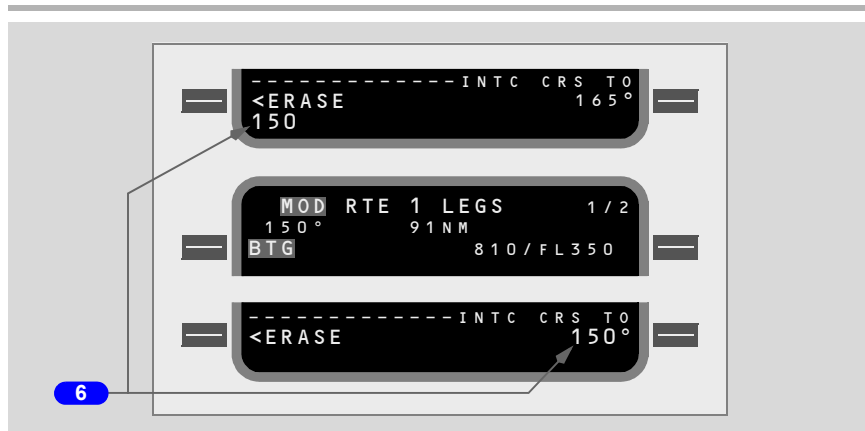
Direct To And Intercept Course To

If the airplane passes the last active route waypoint (or offset) or the last waypoint prior to a route discontinuity, LNAV maintains the current heading and a scratchpad message displays. If LNAV is not active, activation can be accomplished in the following three ways:

- When the airplane is within 2.5 miles of the active leg and on an intercept heading to the active leg, pushing the LNAV switch activates LNAV. The airplane turns to intercept the active leg. If the intercept angle is large, the airplane may overshoot the active leg.
- When more than 2.5 miles from the active leg, pushing the LNAV switch when the airplane is on an intercept heading to the active leg arms LNAV. Activation occurs as necessary to intercept the active leg with no overshoot. The intercept heading must intersect the active leg inbound before the active waypoint.
- Fly direct to a waypoint or intercept a course to a waypoint. Enter a waypoint in the RTE LEGS page active waypoint line to fly direct. Use the INTC CRS TO prompt in line 6R to create an intercept course to the waypoint. Pushing the LNAV switch arms or activates LNAV, depending on the distance to the active leg.

The example below depicts the airplane being off course to the right, followed by a modification to fly direct to BTG.





1 Leg Direction

Direct course from airplane present position to entered waypoint.

Execute to proceed direct to active waypoint.

2 Abeam Points (ABEAM PTS)

Push –

- creates place bearing distance waypoint on the Direct To leg abeam the bypassed waypoint if the bypassed waypoint was a database airport, navaid, NDB, or waypoint
- creates latitude/longitude waypoint on the Direct To leg abeam the bypassed waypoint if the bypassed waypoint was a latitude/longitude waypoint
- creates a new place bearing distance waypoint based on the original “place” on the Direct To leg abeam the bypassed waypoint if the bypassed waypoint was a place bearing distance waypoint
- creates a new latitude/longitude reporting point on the Direct To leg based on the entered latitude or longitude reporting point.
- line title displays ABEAM PTS and line data displays SELECTED
- altitude/speed constraints for bypassed waypoints are removed

ABEAM PTS prompt displays whenever the active waypoint name is modified, usually for direct-to routing.

3 Route Copy (RTE COPY)

Push –

- copies the active route into the inactive route
- erases previous inactive route

- line title displays RTE COPY and line data displays COMPLETE
- subsequent route modifications remove RTE COPY prompt.

4 Intercept Course TO (INTC CRS TO) – Select

Displays whenever the active waypoint name is modified.

Displays boxes if entered waypoint not in the active route.

Displays current route course and prompt caret if entered waypoint in the active route.

When boxes displayed, valid entry is intercept course from 000° through 360°. May be changed until executed. Entered or selected value displays in large font.

Push –

- when current route course (165°) displayed, selects it as intercept course to active waypoint
- displays entry or current route course as course to active waypoint
- removes ABEAM PTS and RTE COPY prompts.

5 Intercept Course

After pushing INTC CRS TO and prior to execution, displays direct-to inbound course at the waypoint; changed by entry in intercept course to (INTC CRS TO) line or by selecting intercept course to. After execution, displays current required track to fly inbound course to the waypoint.

6 Intercept Course TO (INTC CRS TO)

To change intercept course:

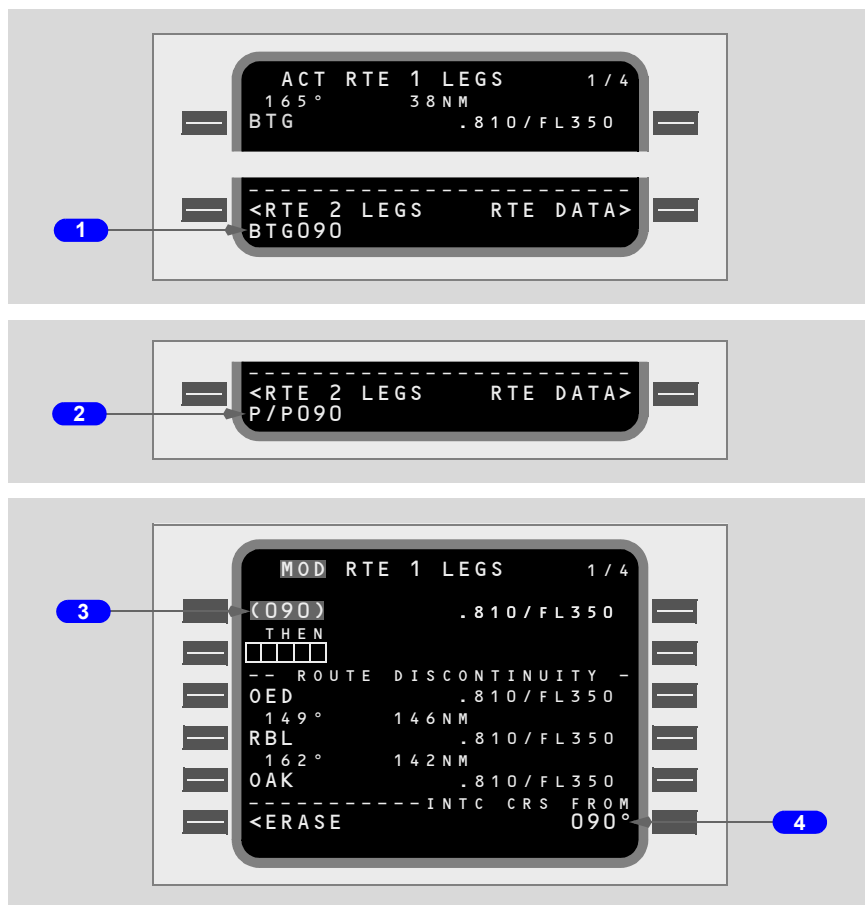
- enter the inbound intercept course (150°) in the scratchpad
- select the INTC CRS TO line to change the leg direction; intercept course to BTG of 150° is entered in the INTC CRS TO line and above the active waypoint.

Intercept Course From

The steps to create an intercept course from a waypoint are like the steps for an intercept course to. The waypoint name in the scratchpad is suffixed with the outbound course.

An intercept course can be created outbound from a waypoint in the navigation data base or from present position. The waypoint does not have to be in the route. Entering a waypoint and course pair in the active waypoint line displays the INTC CRS FROM prompt. The FMC calculates a route leg with the waypoint as the origin of the entered course.

The example shows a 090° course from BTG, entered as BTG090. When this course intercept is line selected to the active waypoint line, the course (090°) displays in the leg direction and the waypoint displays as a conditional waypoint consisting of a course intercept (090°).



1 Waypoint and Outbound Course

Enter the waypoint name and outbound course in the scratchpad.

2 Present Position and Outbound Course

Enter P/P and outbound course in the scratchpad.

3 Active Outbound Course Entry

After the active waypoint line is selected, the outbound course displays. The waypoint name is not used.

For example, BTG090 is entered into the active waypoint line. The FMC calculates a new route leg with BTG as the origin on a outbound course of 090°.

4 Intercept Course From (INTC CRS FROM)

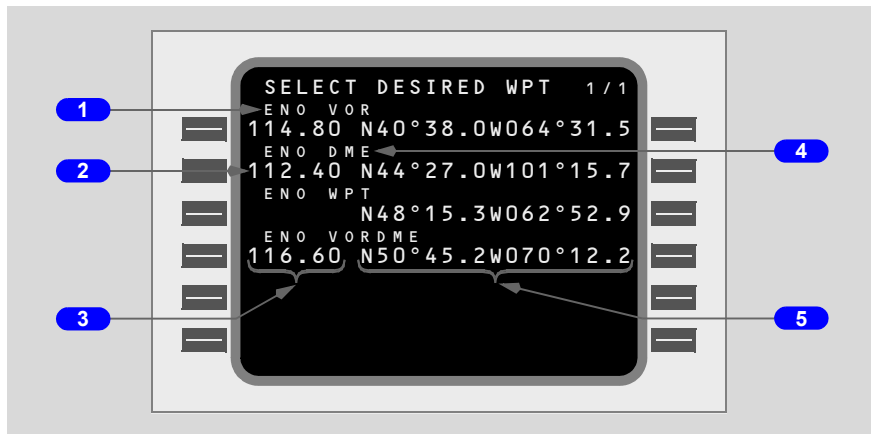
Displays outbound course from entered waypoint.

Shows the active waypoint name is modified with P/P or waypoint outbound entry.

Valid input is any course from 000° through 360°. May be changed until executed.

Select Desired Waypoint Page

The SELECT DESIRED WPT page displays after a waypoint entry when the FMC encounters more than one location for the same waypoint name. Selection of a waypoint returns the display to the previous page.



1 Identifier

Displays the identifier for the duplicate named waypoints. Select the correct waypoint by pushing the applicable left or right line select key.

2 Waypoint Lines

Display a sorted list of waypoints with identifier, navaid type, frequency, and coordinates;

- when page is accessed as a result of a flight plan modification, sort is based on proximity to the waypoint preceding the entered waypoint
- when page is accessed as a result of a DIR/INTC or REF NAV DATA entry, sort is based on proximity to current aircraft position.

Push - selects waypoint location for use; returns display to page previously in use.

Pushing any CDU function key exits page without selecting a waypoint.

3 Frequency

Displays frequency of the navaid.

Blank if the waypoint is not a navaid.

4 Type

Displays the type of navaid for each duplicate name.

Blank if the waypoint is not a navaid.

5 Latitude/Longitude

Displays the latitude/longitude for each duplicate name.

Airway Intercept

Just as in intercept to/from, LNAV can be used to intercept an airway. An airway intercept changes the active waypoint on the RTE and LEGS pages.

Enter the airway identifier under VIA on line 1L of the RTE page. Boxes display under TO for an open-ended airway intercept. Enter the desired airway exit waypoint in the boxes. The FMC selects the waypoint preceding the closest abeam location as the starting waypoint of the new airway. This waypoint displays under TO on line 1R. The entered airway and the selected exit point display on line 2. Executing the modification makes the FMC selected first waypoint the active waypoint; BANDR in the example that follows.

If the clearance heading intercepts the new route before the next downtrack waypoint (BEEZR), LNAV can be armed and will capture, and the active waypoint will sequence to next downtrack waypoint (BEEZR).

If the clearance heading does not intercept the new route before the next downtrack waypoint, the NOT ON INTERCEPT HEADING scratchpad message displays. Use the intercept course to procedure to make the course inbound to the waypoint (after the crossing location) the active leg segment.

Example

The active route is direct to EPH, then direct to MWH. ATC clears the airplane to:

- turn right heading 110°
- intercept V2 to MWH.

Following the V2 modification to MWH and execution, the LEGS page displays this waypoint sequence:

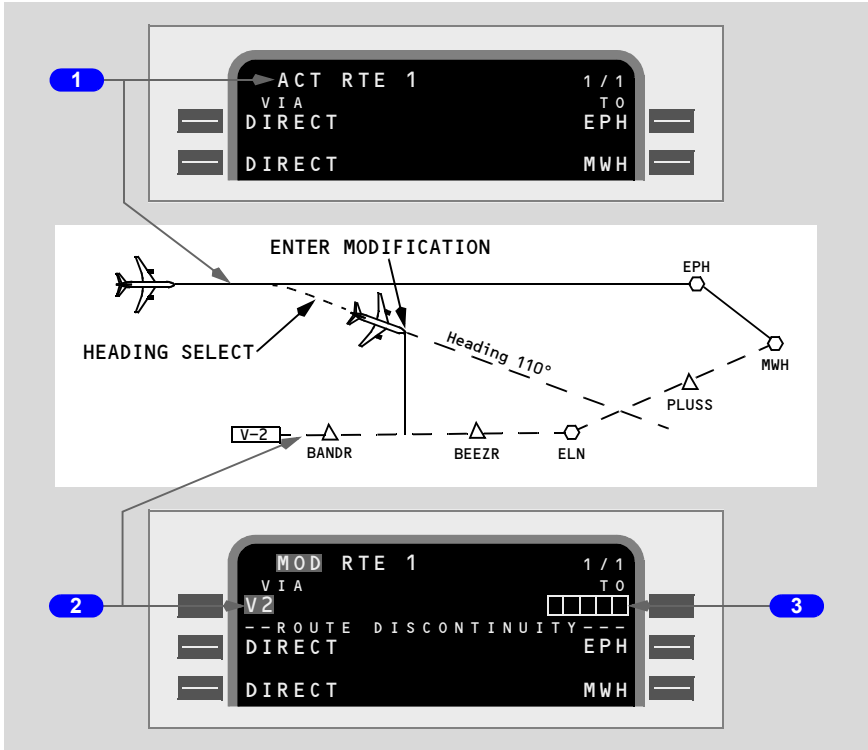
- BANDR
- BEEZR
- ELN

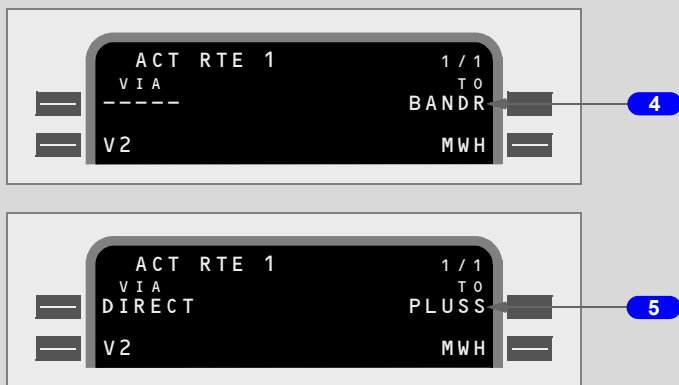
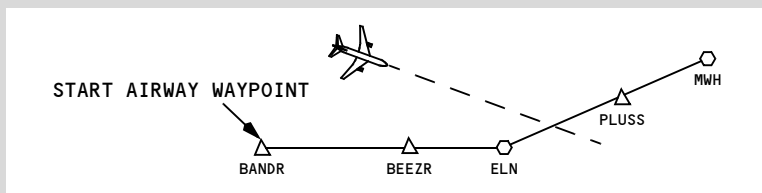
777 Flight Crew Operations Manual

- PLUSS
- MWH

Since the intercept heading will not cross the new route before BEEZR, modify the LEGS page using a course intercept to the waypoint after the crossing location. In this case, it would be PLUSS. PLUSS becomes the active waypoint on the V2 airway. The LEGS page now displays:

- PLUSS
- MWH





1 Active RTE 1 Page

The route page before the ATC clearance.

2 Input Airway

Enter the airway in the first VIA position on the RTE page. Boxes display in the TO position. A route discontinuity follows on the next line.

3 Airway Exit

Enter desired airway exit point in the boxes.

4 Start Airway Waypoint

After entering MWH in the boxes:

- the FMC selects BANDR as the airway start waypoint
- the airway line moves down one line
- dashes display in the VIA to the start airway waypoint.

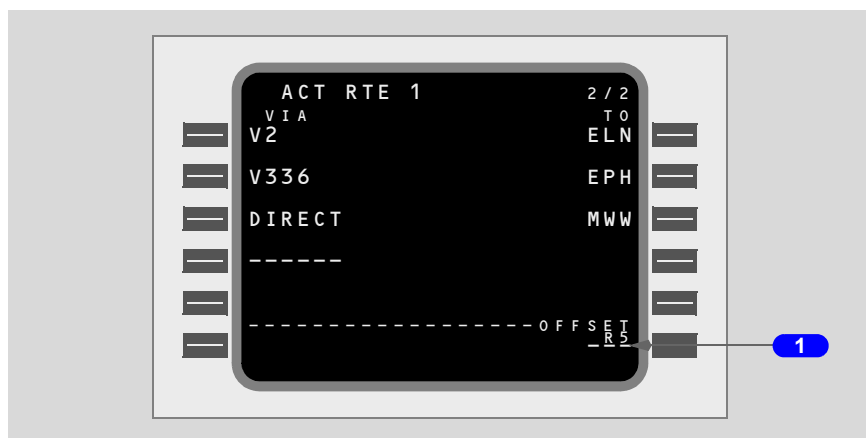
5 New Active Waypoint

Following the course intercept to PLUSS modification and execution, the LEGS page displays PLUSS as the active waypoint. LNAV can be armed and the airway intercept can be completed.

Route Offset

Select route offsets on the RTE page 1. The OFFSET prompt displays when the airplane is in flight and not on a SID, STAR, or transition. The offset displays as a white dashed line on the ND until the offset modification is executed or erased. After execution, the offset route displays as a dashed magenta line. The original route continues to display as a solid magenta line. When executing the offset modification with LNAV active, the airplane turns to capture the offset course.

When on the route offset, active route waypoints sequence normally. However, during transition to or from an offset route greater than 21 nm, the crosstrack limit is extended to 200 nm.

**1 OFFSET**

Enter the necessary offset. When executed, the CDU OFST light illuminates.

Valid entries are L (left) or R (right) XX (XX is any number from 0 to 99 nm).

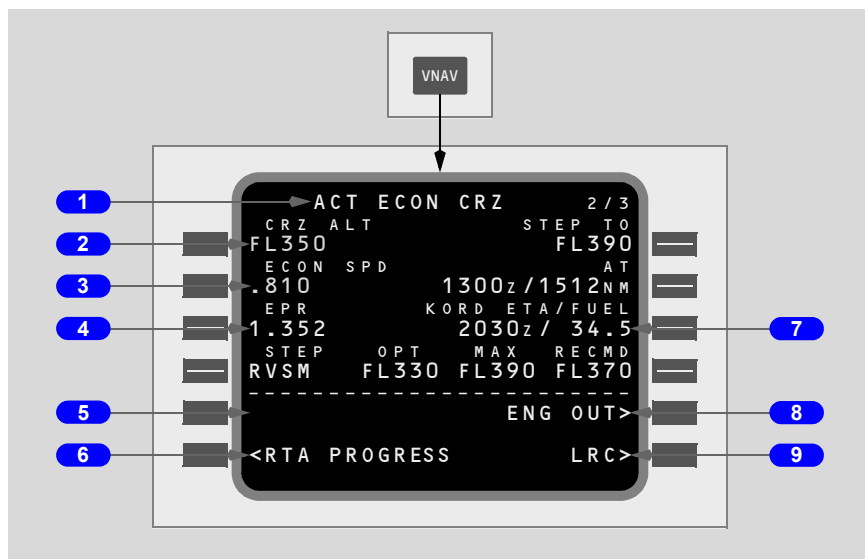
An offset propagates along the route to a Standard Terminal Arrival Route (STAR), approach or approach transition, discontinuity, end of route, track change greater than 135°, or holding pattern. An offset can be removed by deleting the offset, entering an offset value of zero, or proceeding direct to a waypoint.

Cruise Page

All Engine Cruise

The cruise page is used to monitor and change cruise altitude and speed. Speed changes can be manually selected or automatically selected with the selection of other VNAV modes. Cruise climbs, cruise descents, and step climbs can be accomplished from the cruise page.

When using VNAV in economy mode, page data is based on operating at ECON SPD. Economy cruise speed is based on cost index. When the flight crew enters a selected speed, page data changes. When the FMC is in the engine out mode, the data reflects airplane capabilities with one engine inoperative. The long range cruise (LRC) mode calculates speeds to maximize airplane range.



1 Page Title

The page title displays active (ACT) or modified (MOD) cruise. Usually, the title contains ECON for economy cruise. Selected speeds, engine out, and long range cruise modify the title.

Page titles include:

- ECON CRZ – speed based on cost index
- ECON CRZ CLB or CRZ DES – cruise climb or descent with ECON selected
- LRC CRZ – long range cruise selected
- LRC CRZ CLB or DES - cruise climb or descent with LRC selected

- RTA CRZ - RTA cruise selected
- RTA CRZ CLB or DES - cruise climb or descent with RTA selected
- MCP SPD CRZ – selected MCP cruise speed.
- EO CRZ – engine out mode with EO SPD selected
- EO D/D – engine out mode with the airplane altitude above the maximum altitude for engine out performance
- CO CRZ – engine out mode with CO speed selected
- LRC D/D - engine out mode with LRC selected
- EO LRC CRZ - displays after descending to engine out maximum altitude

2 Cruise Altitude (CRZ ALT)

Displays cruise altitude entered on PERF INIT page.

Valid entries are: XXX, XXXX, XXXXX, OR FLXXX. Altitude displays in feet or flight level depending on the transition altitude.

Modified values display in shaded white.

A new entry changes the page title to CRZ CLB or CRZ DES.

Changing the MCP altitude and pushing the altitude selector enters the MCP altitude as the active cruise altitude, without creating a modification.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

Displays target speed or Mach in magenta.

MOD displays in the page title in shaded white until the modification is erased or executed.

SEL SPD displays when flight crew enters speed.

LRC or company (CO SPD) display when selected, depending on the VNAV mode.

4 EPR

[Option - PW, RR Engines]

Displays EPR to maintain level flight at the target airspeed.

4 N1

[Option - GE Engines]

Displays N1 to maintain level flight at the target airspeed.

5 Economy Speed or Required Time Of Arrival RTA/Economy (ECON, RTA/ECON)

ECON

- Push – selects VNAV ECON mode.
- Displays when an RTA waypoint is not in the flight plan and VNAV is not in the economy mode.

RTA/ECON

- Push – selects RTA speed mode. Displays ECON prompt.
- Displays when an RTA waypoint is in the flight plan and VNAV is not in the RTA mode.

6 Required Time Of Arrival (RTA) PROGRESS

Push – displays RTA PROGRESS 3/4.

7 XXXX (Destination) ETA/FUEL, ETA/FUEL W/MOD

Displays estimated time of arrival and calculated fuel remaining at the destination.

Line Title displays "ETA/FUEL W/MOD" when a modified route is displayed.

Displays the same data for the alternate airport when a DIVERT NOW modification is selected from the ALTN page.

Calculations are based on optimum step climbs and cruise altitudes.

8 Engine Out (ENG OUT)

Push –

- displays MOD XXX CRZ page title; XXX is the active all engine CRZ speed mode before ENG OUT is selected
- changes command speed line title to EO SPD
- below engine-out maximum altitude: upon execution, thrust reference limit changes to CON and page title becomes ACT EO CRZ
- above engine-out maximum altitude: sets CRZ ALT to engine-out maximum altitude; and upon execution, thrust reference limit becomes CON and page title becomes ACT EO D/D

9 Long Range Cruise (LRC)

Push – displays long range cruise page.

Engine Out Cruise

Engine out VNAV guidance displays on the EO CRZ or EO D/D page. Engine-out data is also available with both engines operating by selecting the EO OUT prompt.

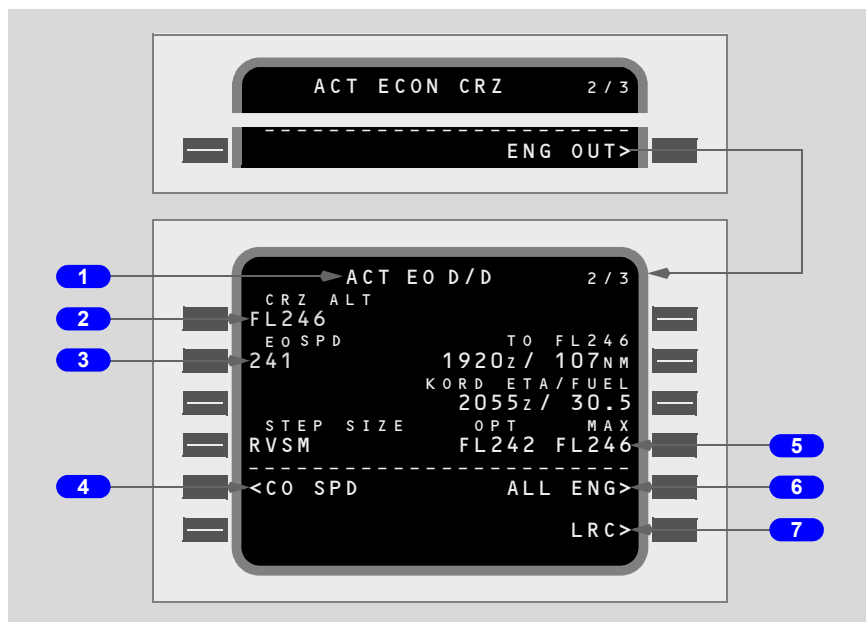
777 Flight Crew Operations Manual

The modified page displays engine-out performance information. When above the maximum engine-out cruise altitude, VNAV calculates engine-out guidance for drift down (D/D). The EO D/D page changes to the EO LRC CRZ page when reaching the engine-out cruise altitude.

Subsequent engine-out cruise climb or descent is accomplished the same as two engine cruise climb or descent.

As the airplane gross weight decreases, maximum altitude increases. A step climb may be possible under these conditions.

The example is based on a cruise altitude above the maximum engine-out altitude. When ENG OUT is selected, the default target speed is EO SPD.

**1 Page Title**

Displays LRC D/D when LRC selected

Displays MCP SPD D/D when MCP speed selected

Displays EO LRC CRZ when reaching engine out cruise altitude

Displays EO CRZ CLB or EO CRZ DES when EO SPD selected and the airplane is below the engine-out maximum altitude.

2 Cruise Altitude (CRZ ALT)

Displays altitude from MAX ALT line when current CRZ ALT above MAX ALT.

Manual entry of an altitude above maximum engine-out altitude results in the scratchpad message, “MAX ALT FLXXX”.

Valid entries are the same as all engine cruise page.

3 Engine Out Speed (EO SPD)

Displays the target speed or Mach in magenta.

Manual entry is allowed.

Valid entries are the same as all engine cruise page.

A manually entered speed changes the line title to SEL SPD.

Selecting any speed shows engine out speed (EO SPD) as a select prompt at 6L.

Manual entries may change MAX altitude.

4 Company Speed (CO SPD)

Push – Modifies the page with company speed, engine out data from the Airline Policy page.

5 Optimum Altitude and Maximum Altitude (OPT, MAX)

OPT – displays the optimum altitude based on airplane gross weight and speed displayed on the speed line.

MAX – displays the maximum cruise altitude based on:

- current gross weight
- engine out operation
- selected speed option
- disregarding any altitude or speed constraints, and
- residual climb rate of 100 feet per minute.

6 ALL Engine (ENG)

Push – displays a MOD XXX CRZ page with performance based on both engines operating.

Selection and execution allows subsequent selection of two engine economy VNAV modes.

7 Long Range Cruise (LRC)

Push – enables execution of engine out long range cruise.

Displayed when EO or SEL SPD is the active mode.

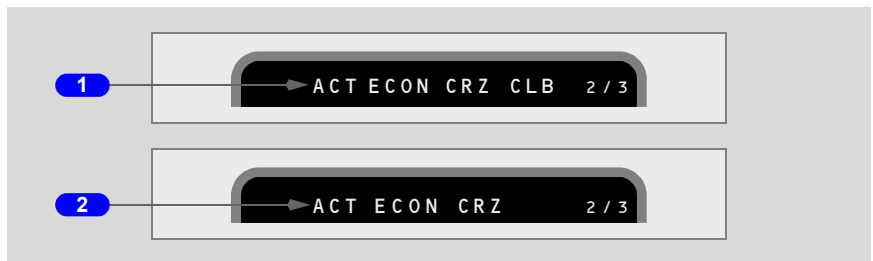
VNAV Modifications

During the cruise phase, VNAV can calculate two types of climbs: cruise and step climbs. Cruise and planned climbs can be entered by the flight crew. Optimum step climbs are calculated by the FMC. In all cases, the new climb altitude must be selected in the MCP altitude window before VNAV commands the climb.

Cruise Climb

Setting an altitude above the current cruise altitude in the MCP altitude window and pushing the altitude selector causes the cruise altitude to be set to the MCP altitude and the airplane to climb to the new cruise altitude. The reference thrust limit is CLB and the pitch flight mode annunciation is VNAV SPD.

Another method to accomplish a cruise climb: set a higher MCP altitude, enter the altitude in the CRZ ALT line, and execute.



1 During Cruise Climb

VNAV page title displays CRZ CLB in a climb to cruise altitude.

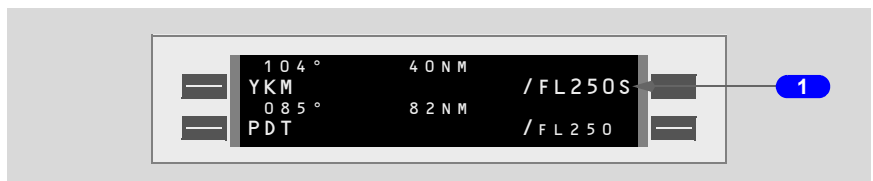
2 End of Cruise Climb

VNAV page title displays ECON CRZ after level off at cruise altitude.

Planned Step Climb

When a step climb is planned to start at a waypoint, the data can be entered on the RTE LEGS page. The FMC performance predictions assume the airplane will start the climb at the identified waypoint.

The FMC displays the distance and ETA to the step point on the PROGRESS page. The corresponding altitude profile point and identifier is shown on the ND.



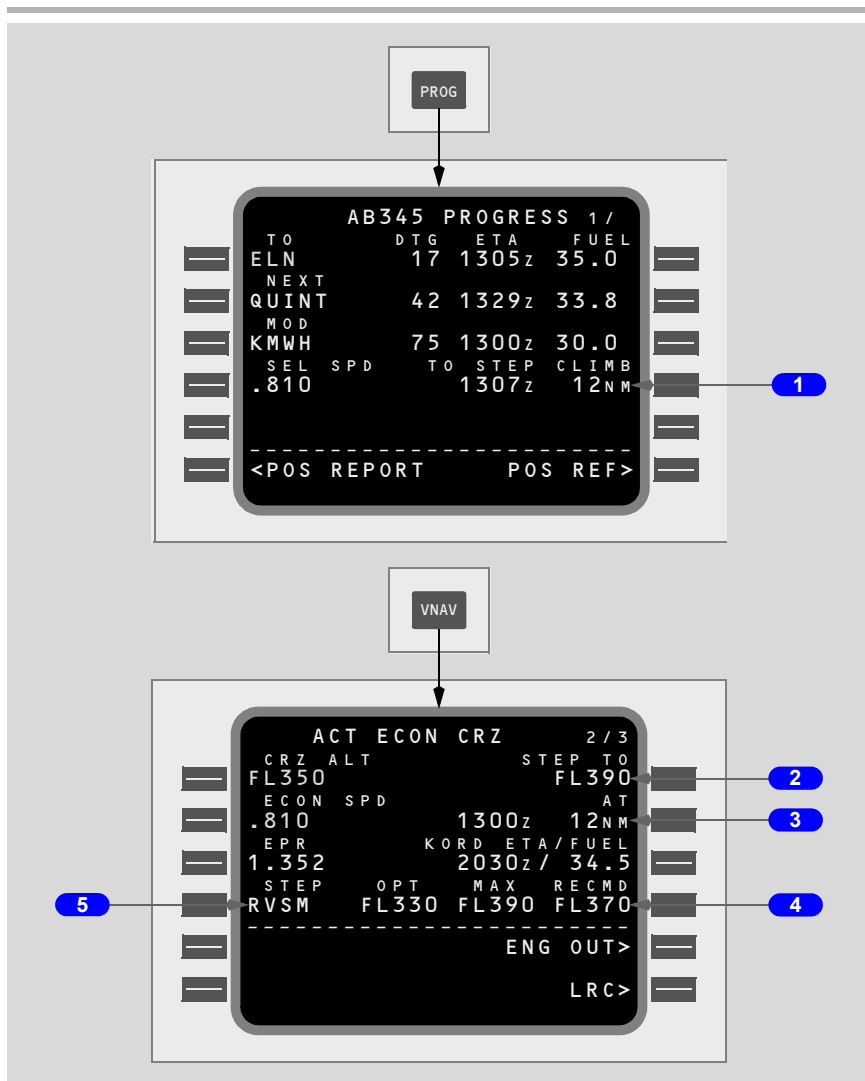
1 Step Climb Altitude

Enter the cruise altitude as an altitude constraint and the letter S. The FMC assumes the step climb starts at the waypoint. Accomplish the step climb at the waypoint with the steps described in cruise climb.

Calculated Step Climb

When a non-zero value is entered into the STEP SIZE line on the PERF INIT or CRZ page, the FMC calculates optimum points for step climbs as the airplane performance permits. The climb altitude is determined by the value in STEP SIZE. Multiple step climbs are possible based on performance and route length. VNAV commands the step climbs, if the MCP altitude and the FMC CRZ ALT are set to the new altitude.

The FMC calculates step climb points as a function of lateral flight plan, speed mode, present and step to altitude, and gross weight. The gross weight for a step from present CRZ ALT to STEP TO altitude is the gross weight at which the optimum altitude is halfway between the two altitudes.

**1 TO STEP CLIMB**

When the cruise climb start point is the next VNAV event, the line title changes to TO STEP CLIMB.

Displays the ETA and DTG to the point where the step climb starts.

If the airplane passes the step climb point and has not started to climb, the ETA and DTG are replaced with the word NOW.

When the FMC calculates a step climb is not advised, the ETA and DTG are replaced with the word NONE.

2 STEP TO

An altitude can be entered for a step climb evaluation. The FMC calculates the predicted step climb data and displays the results on this page and the PROGRESS page.

Entering a zero value for STEP SIZE causes the FMC to calculate performance based on a constant altitude flight at the CRZ ALT. Entering a valid, non-zero increment or ICAO step size causes the FMC to calculate performance based on accomplishing step climbs at calculated step climb points.

Step climb altitudes entered on the RTE LEGS page can be higher or lower than the CRZ ALT. These step climb altitudes cannot be overwritten on the CRZ page.

When using the ICAO step size, the STEP TO altitude is the next higher altitude above the OPT altitude corresponding to the direction of flight, based on the CRZ ALT entered before takeoff. Changes to CRZ ALT while in flight do not affect calculation of STEP TO altitudes using ICAO step sizes. However, if an alternate route (for example, Route 2) is activated in flight, the hemispheric altitude will be calculated using the current CRZ ALT.

When using an altitude increment step size, the STEP TO altitude is the next higher altitude above OPT calculated by adding the STEP SIZE increment to the FMC CRZ ALT.

When entering a cruise altitude above maximum altitude, the scratchpad message MAX ALT FLXXX displays.

Entry of a new cruise altitude deletes all waypoint altitude constraints at or above the new cruise altitude.

Displays:

- the STEP TO altitude from the RTE LEGS page
- a calculated step climb altitude based on the step size.

Manual entry is allowed.

Blank when:

- there is no active flight plan, or
- within 200 NM of the T/D point, or
- within 500 NM of the destination, or
- in the EO D/D phase.

3 AT

Displays the ETA and DTG to the step climb point where a climb to the STEP TO altitude minimizes trip cost (ECON CRZ) or fuel (other CRZ speed).

Displays NOW passing the step climb point.

Line title changes to AVAIL AT when the climb is restricted by thrust or buffet.

Line title changes to TO T/D when within 200 NM of the top of descent or within 500 NM of the destination. ETA and DTG are relative to the T/D point.

The data is the same as displayed on the PROGRESS page.

4 Optimum Altitude, Maximum Altitude, and Recommended Altitude (OPT, MAX, RECMD)

Blank when RTA is active.

OPT –

- with ECON speed selected, displays altitude which minimizes trip cost based on weight and cost index
- with LRC, EO, CO, or SEL speed selected, displays altitude which minimizes trip fuel based on weight
- does not reflect the effect of speed if speed intervention (MCP IAS/MACH window) is selected.

MAX – displays maximum sustainable altitude based on:

- current gross weight
- temperature
- number of engines operating
- cruise reference thrust limit default set by airline (CRZ or CLB)
- speed (ECON, LRC, SEL, EO, or CO) option
- residual rate of climb default set by airline (range: 100 to 999 feet per minute)
- disregarding altitude or speed constraints
- does not reflect the effect of speed if speed intervention (MCP IAS/MACH window) is selected.

RECMD – displays the most economical altitude to fly for the next 500 nm based on gross weight; selected cruise speed, including specified cruise speed segments; and constant altitude cruise over a fixed distance taking into account the route of flight, entered winds, and temperature forecast. The FMC evaluates altitudes up to 9,000 feet below the current CRZ ALT and up to less than MAX altitude. Recommended altitudes are selected consistent with the step climb schedule and specified step size. If a step size of zero has been selected, the recommended cruise level is selected assuming a 2,000 foot step size. The recommended altitude is set to the CRZ ALT when within 500 nm of the T/D.

Note: The recommended altitude may be above or below cruise altitude. Refer to RTE DATA and WIND pages for wind and temperature data.

For RTA CRZ mode active: OPT, MAX, and RECMD are not computed. OPT, MAX, and RECMD headers are blank.

5 STEP SIZE

Used for calculation of optimum step point and step climb predictions.

Displays default step climb size: RVSM, ICAO, or 0 as selected in AMI.

Valid entries are:

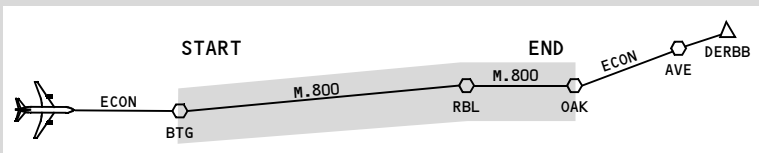
- "0" to inhibit predicted step climbs, or
- altitudes from 1000 to 9900 in 100 foot increments, or
- "I" for ICAO, or
- "R" for RVSM

Deletion of a manual entry returns step size to the default value.

Constant Speed Cruise

A speed for a cruise segment can be specified. A cruise segment has a start waypoint and an end waypoint. The airplane maintains a constant speed between the two waypoints. The waypoints must be in the cruise phase. The FMC controls the speed after the end waypoint or top of descent.

Modification must be executed.



MOD	RTE	1	LEGS	1 / 4
165°			38 NM	
BTG			.800 / FL350	
156°			337 NM	
RBL			.800 / FL350	
162°			142 NM	
OAK			ECON / FL350	
121°			165 NM	
AVE			.808 / FL350	
129°			29 NM	
DERBB			.808 / FL350	
<ERASE				RTE DATA>

1 Start Waypoint for Constant Speed Cruise

The constant speed cruise starts at BTG at .800 Mach. Entry is in Mach.

2 End Waypoint for Constant Speed Cruise

The constant speed cruise ends at OAK then ECON speed is used. If an RTA waypoint exists at RBL or OAK, the RTA is deleted.

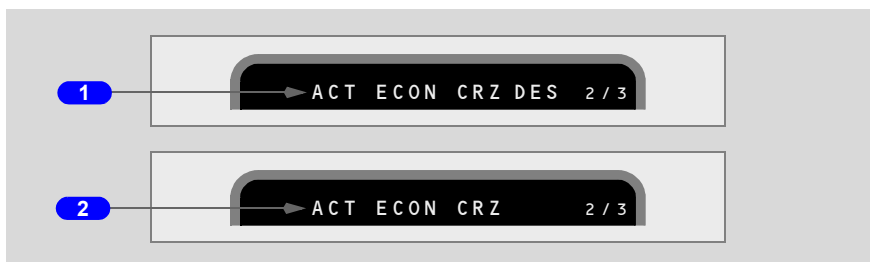
Entry can be a Mach number, ECON/ or E/, LRC/ or L/. If an RTA waypoint is in the flight plan, RTA/ or R/ may be entered.

If no end waypoint is specified, the constant speed terminates at top of descent.

The FMC may select the end waypoint if an RTA waypoint is entered. The FMC selects the end waypoint to allow enough distance to arrive at the RTA waypoint on time. In the example, if the FMC selected OAK as the end waypoint, RTA would replace ECON. See RTA PROGRESS page 3/4.

Cruise Descent

Setting an altitude below the current altitude in the MCP altitude window and pushing the altitude selector (more than 50 nm from a T/D) causes the cruise altitude to be set to the MCP altitude and the airplane to descend to the new altitude. The CRZ page displays ACT ECON CRZ DES 2 / 3. If the altitude set in the altitude window is below the speed transition (SPD TRANS) or restriction (SPD RESTR) altitude displayed on the DES page, those altitudes and speeds are deleted. Transition or speed restrictions must be maintained by flight crew action. The autothrottle sets a calculated thrust value for an approximate 1250 feet per minute descent. Pitch changes maintain the commanded cruise speed. Thrust levers can be manually positioned to adjust the descent rate.

**1 During Cruise Descent**

VNAV page title displays cruise phase in a descent to a new cruise altitude.

2 End of Cruise Descent

VNAV page title displays cruise phase after level off at new cruise altitude.

Early Descent

An early descent is a descent started prior to the T/D. The VNAV descent page becomes active.

During cruise, setting an altitude below the current altitude in the MCP altitude window and pushing the altitude selector activates the DES NOW function when the airplane is within 50 nm of the T/D or if the MCP altitude is set below the highest descent altitude constraint in the VNAV descent profile.

The autothrottle sets thrust to maintain the target descent rate; then annunciates HOLD. Pitch maintains the commanded speed. Thrust levers can be manually positioned to adjust the descent rate.

Another method to accomplish an early descent: set a lower MCP altitude, page forward to the VNAV DES page and line select DES NOW, and execute.



1 Descend Now (DES NOW)

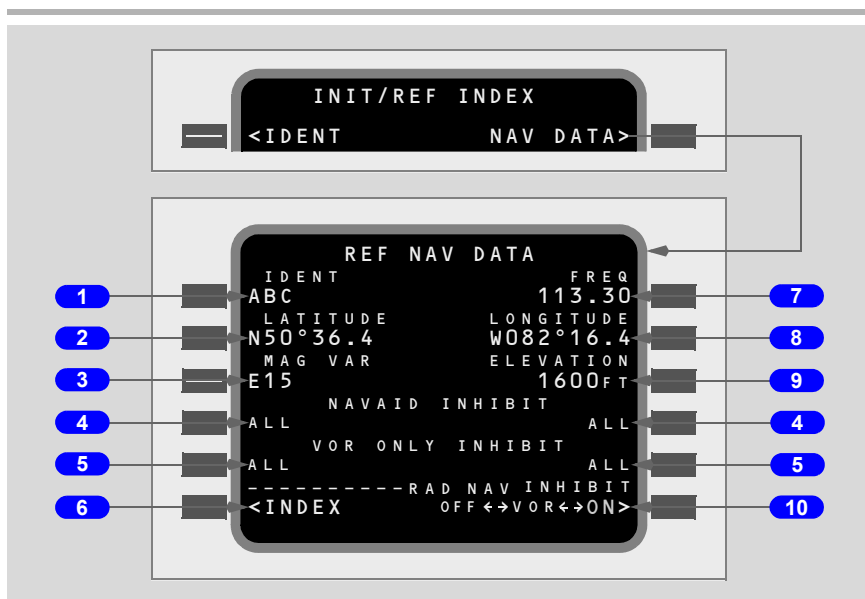
The DES NOW prompt is shown on the descent page when the cruise phase is active. Select the DES NOW prompt and execute to start a VNAV ECON descent of approximately 1250 feet per minute at ECON speed.

Upon reaching the planned descent path, VNAV commands pitch to maintain the planned descent path and ECON speed. If the airplane reaches an altitude constraint, VNAV changes to VNAV ALT until the planned descent path is intercepted.

Navigation Data

Reference Navigation Data Page

The reference navigation data page displays data about waypoints, nav aids, airports, and runways. Use this page to inhibit FMC position updates from radio nav aids. The nav aids are always available for manual tune, autotune and the ND.



1 Identification (IDENT)

Valid entries are any waypoint, navaid, airport, or runway from the navigation database.

Entry changes to dashes when page is exited and then reselected.

2 LATITUDE

Displays latitude of entered identifier.

3 Magnetic Variation (MAG VAR), LENGTH

MAG VAR - displays magnetic variation when entered identifier is a navaid.

LENGTH - displays runway length when entered identifier is a runway.

4 NAVAID INHIBIT

Valid entries are: VOR, VOR/DME, VORTAC, or DME identifiers from the navigation database.

Entries not allowed when RAD NAV INHIBIT displays ON in large font, green letters.

Inhibits use of entered navaids for updating by both FMCs.

Entries clear at flight completion. "ALL" displays.

Deleting or overwriting removes a previous inhibit navaid.

5 VOR ONLY INHIBIT

Valid entries are VOR identifiers from the navigation database.

Entries not allowed when RAD NAV INHIBIT displays ON or VOR in large font, green letters.

Inhibits use of only VOR portion of entered navaid for updating by both FMCs. DME-DME position updating is not inhibited.

Entries clear at flight completion. "ALL" displays.

Deleting or overwriting removes a previous inhibit VOR.

6 INDEX

Push – displays the INIT/REF INDEX page.

7 Frequency (FREQ)

Displays frequency of entered identifier when it is a navaid.

8 LONGITUDE

Displays longitude of entered identifier.

9 ELEVATION

Displays elevation of entered identifier when it is a navaid, airport, or runway.

10 RAD NAV INHIBIT

The default state of RAD NAV INHIBIT is ON; all radio updating (DME/DME, VOR/DME, LOC) is inhibited. "ALL" displays in NAVAID INHIBIT and VOR ONLY INHIBIT left and right lines. Entries are not allowed.

Push – alternately selects RAD NAV INHIBIT: OFF, VOR, or ON.

OFF - all radio updating available to the FMC. OFF displays in large font, green letters. VOR and ON display in small font, white letters.

VOR - all VOR/DME updating inhibited. DME/DME updating is operable. VOR displays in large font, green letters. OFF and ON display in small font, white letters.

ON - all radio updating inhibited. ON displays in large font, green letters. OFF and VOR display in small font, white letters.

Note: When GPS is operable, radio updating is available, but is not used by the FMC for position updating.

Fix Information Page

[Option - Standard FIX Pages]

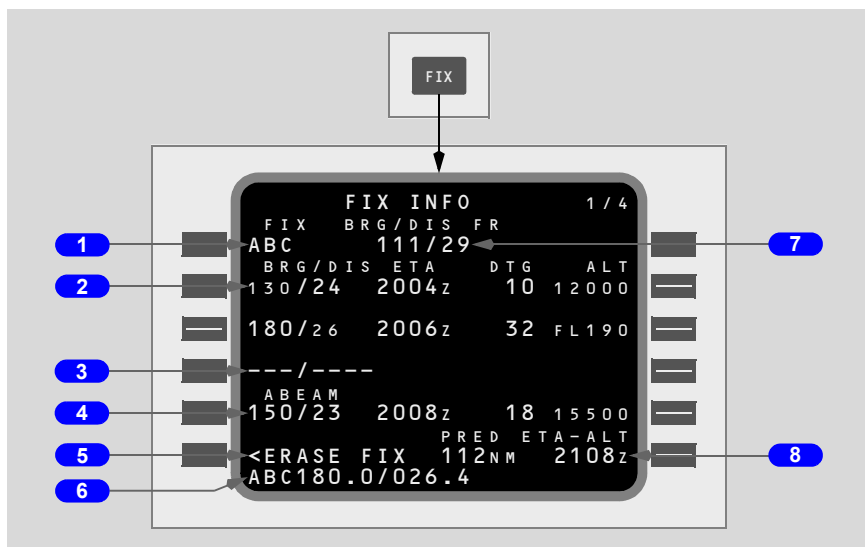
Two identical FIX INFORMATION pages are used to create waypoint fixes and waypoints for the ND. Some of the created waypoints can be copied into the route. The page can be cleared by selecting the ERASE FIX prompt or by using the DEL key.

[Option - Enhanced FIX Pages]

Four identical FIX INFORMATION pages are used to create waypoint fixes and waypoints for the ND. Some of the created waypoints can be copied into the route. The page can be cleared by selecting the ERASE FIX prompt or by using the DEL key.

Magnetic/True Bearing

Magnetic or true fix bearings depend on airplane location. Refer to FMC Polar Operations, Flight Management Navigation, section 31.



1 FIX

[Option - Standard FIX Pages]

Valid entries are airports, nav aids, and waypoints from the navigation database. The selected fix displays on the ND and is highlighted by a green circle.

1 FIX

[Option - Enhanced FIX Pages]

Valid entries are airports, nav aids, place bearing distance, place bearing/place bearing, along track, latitude/longitude, and waypoints from the navigation database. The selected fix displays on the ND and is highlighted by a green circle.

2 Bearing/Distance (BRG/DIS), ETA, DTG, ALT

Valid entries are XXX/YYY.Y:

- decimal values can be omitted
- leading zeros can be omitted for distance entries

[Option - Standard FIX Pages]

- distance (up to 511 nm) only entries must start with a slash (/).

[Option - Enhanced FIX Pages]

- distance (up to 9999nm) only entries must start with a slash (/).

Distances from the fix display on the ND as a circle around the fix.

When the circle intersects the active route, the ETA, DTG, and predicted altitude at the intersection display for the closest of the two intersections.

Bearings from the fix display on the ND as radial lines from the fix.

When the bearing intersects the active route, the ETA, DTG, and predicted altitude at the intersection display.

ETA – displays the estimated time of arrival to the intersection point.

DTG – displays the distance to go to the intersection point.

ALT – displays the predicted altitude at the intersection point.

Push - copies the fix place/bearing/distance into the scratchpad. This fix can be placed in the route on a LEGS or RTE page as a waypoint.

3 Bearing/Distance (BRG/DIS) – Dashes

Enter a bearing, distance, or both bearing and distance from the fix. A bearing and distance from the fix displays on the ND as a waypoint fix point. ETA, DTG, and predicted do not display.

4 ABEAM

Displays ABEAM prompt.

Push - displays bearing and distance from the fix perpendicular to the nearest segment of the flight plan path, and ETA, DTG, and altitude at the intersection point.

Second push - copies the fix place/bearing/distance into the scratchpad. This fix can be placed in the route on a LEGS or RTE page as a waypoint.

5 ERASE FIX

Push – removes all fix data from the page and the ND.

6 Route Intersection Point Copied

Pushing the line select key for one of the BRG/DIS entries copies the fix place/bearing/distance definition into the scratchpad. This fix can be placed into the route on a LEGS page as a waypoint.

7 Bearing/Distance From (BRG/DIS FR)

Displays the bearing and distance of the airplane from the fix.

8 Predicted Distance to ETA or Altitude (PRED ETA-ALT)

Valid entry is altitude, flight level, or time. Time entry must be followed by “Z”.

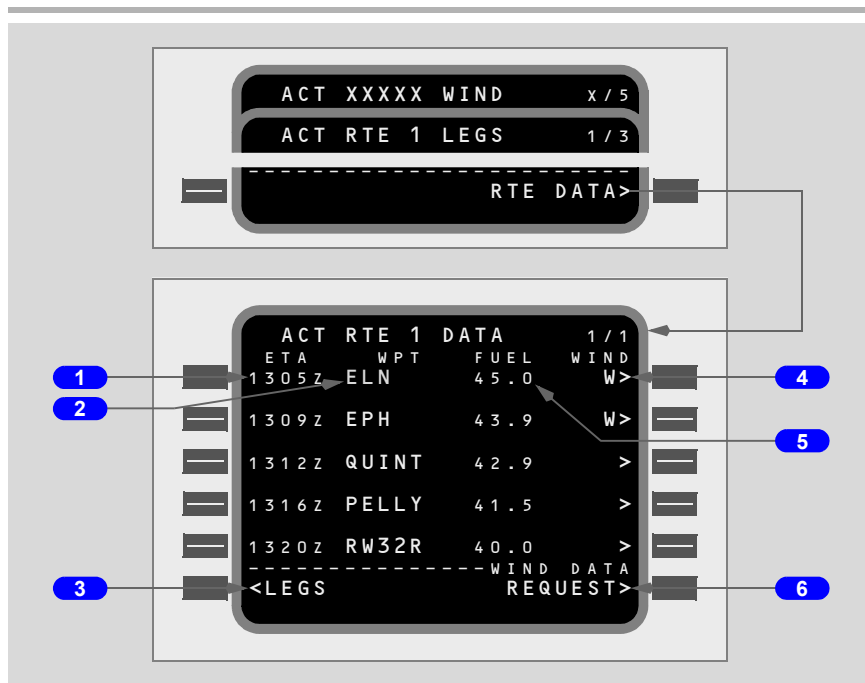
Entering an altitude or flight level displays the predicted along track distance and altitude or flight level on this line. The predicted airplane position displays on the ND route line as a green circle with the entered altitude/flight level.

Entering a time displays the predicted along track distance and the time. The predicted airplane position displays on the ND route line as a green circle with the entered ETA.

Route and Waypoint Data**Route Data Page**

The route data page displays data for each waypoint on the ACT RTE X LEGS page. This page also allows access to the WIND page. This page is available only for the active route.

The ETA and calculated fuel remaining at the waypoint display for each waypoint. Manual entry is not possible.



1 ETA

Displays ETA for waypoint.

2 Waypoint (WPT)

Displays identifier for waypoint.

3 LEGS

Push –displays RTE LEGS page.

4 WIND (W>/>)

W> - indicates waypoint winds have been entered.

> - winds not entered.

Push – selects WIND page for the selected waypoint.

5 FUEL

Displays the FMC calculated fuel remaining at the waypoint.

Note: ETA and estimated fuel calculations assume a direct flight across route discontinuities.

6 WIND DATA REQUEST

Push – transmits a data link request for wind and descent forecast data.

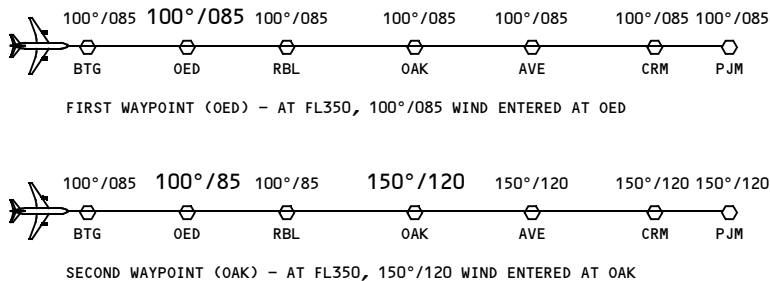
Flight crew may enter up to four altitudes on any wind page to qualify the request.

Wind Data

The FMC uses wind data to improve performance prediction accuracy. Wind data includes altitude and direction/speed.

The FMC applies the first entered wind data to all waypoints in the flight plan. Wind data entered at another waypoint (at the same altitude) changes wind data downtrack from the second entered waypoint either to the end of the track, or to the next entered wind. The wind data before the second entered waypoint does not change. Therefore, enter wind data for waypoints closest to the airplane, then enter wind data for waypoints downtrack from the airplane.

For example: at FL 350, 100°/085 is entered at waypoint OED. All waypoints in the route have the OED wind data. Then, additional wind data entered at OAK changes the wind data at OAK and through the end of the route.



Entered wind data are mixed with sensed wind data for performance predictions. The FMC uses entered winds for predictions far ahead of the airplane and sensed winds close to the airplane. The FMC mixes these winds for predictions in between. Sensed winds display on the progress page 2/4.

Inaccurate forecast wind and temperature information degrades the accuracy of the recommended altitude displayed on the cruise page.

The FMC adjusts ECON climb speed and top of climb using entered and/or sensed wind speed. FMC calculated ECON climb speed may fluctuate if top of climb is near a waypoint with approximately a 45 degree or larger track change and if a significant wind velocity has been entered or is predicted for that waypoint. This fluctuation does not occur when using a manually entered climb speed or speed intervention.

Wind Page

The wind page is used to enter forecast winds and temperatures at waypoints for up to four altitudes to enhance VNAV performance.

This data can be uplinked or manually entered.

Wind speed and direction are entered for the specific altitudes.

OAT can be entered for any one altitude. The FMC calculates the temperature for the entered altitudes using the standard lapse rate.

Altitudes are entered first. The altitudes can be entered in any order and are sorted and displayed in ascending order.

The diagram shows the Wind Page display with the following layout:

- Top Section:**
 - ACT RTE 1 DATA 1 / 1
 - ETA WPT FUEL WIND
 - 1305Z ELN 45.0 W>
- Main Section:**
 - 1** (Page Title): MOD ELN WIND 1 / 5
 - 2** (Altitude): ALT OAT DIR / SPD
 - 3** (Altitude): FL250 -41 °C 280° / 70KT
 - 4** (Altitude): FL210 -33 °C 300° / 50KT
 - 5** (Altitude): 17000 -25 °C ---° / ---KT
 - 6** (Altitude): ALT / OAT FL200 / -31 °C
 - 7** (Altitude): <ERASE RTE DATA>

1 Page Title

Displays ACT XXXXX, where XXXXX is the waypoint at which winds have been entered.

When a route is being modified, MOD in shaded white as shown in the page title.

2 Altitude (ALT)

Enter altitude or flight level for wind entries. Altitude data entry possible only on line 1L.

After data entry, data is sorted by altitude and placed in lines 1 through 4. Dashes display on right side of line for wind direction and speed entry.

When all four lines have data, one must be deleted before new data can be entered.

3 Altitude/Flight Level Data

Displays the altitude or flight level for wind or OAT entries.

Data entered on 1L displays on lines 1 through 4. Data entry is not possible in lines 2L through 4L.

OAT entries made using the ALT/OAT line display in large font. Calculated OAT based on standard lapse rate display in small font.

4 ERASE

Push – removes modified data.

5 Direction and Speed (DIR/SPD)

Displays dashes after altitude/flight level entry in the ALT line. Enter wind direction and speed for the altitude.

Displays entered wind direction and speed for related altitude.

Values propagate in both directions for the first wind entered and downtrack for other entered winds. Propagated values display in small white font.

Manual entries display in shaded white until executed, then in large white font.

6 Altitude/Outside Air Temperature (ALT/OAT)

Enter altitude and OAT. The altitude for OAT does not have to be one of the wind altitudes. The FMC uses standard lapse rate to calculate the temperature at the other altitudes.

Manual entries display in shaded white until executed.

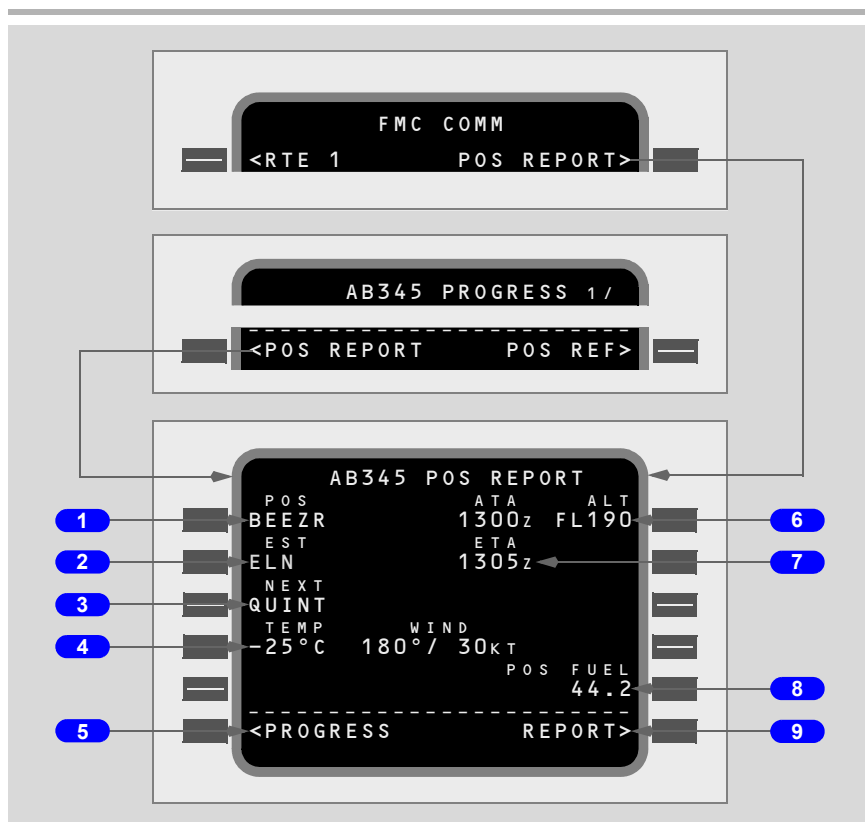
7 Route Data (RTE DATA)

Push – displays the RTE DATA page.

Position Report Page

The position report page displays data for a position report. A position report can be data linked from the page.

The page contains reference data only. Manual entries are inhibited.



1 Position (POS)

Waypoint used to report position. This is the previous active waypoint.

2 Estimate (EST)

The active waypoint displays in magenta.

3 NEXT

Waypoint after active waypoint.

4 Temperature and Wind (TEMP WIND)

TEMP displays the OAT in degrees C.

WIND displays the wind direction and speed.

5 PROGRESS

Push – displays the PROGRESS page.

6 Actual Time of Arrival and Altitude (ATA ALT)

ATA displays the actual time of arrival for the POS waypoint.

ALT displays the airplane altitude at last waypoint.

7 ETA

Displays the estimated time of arrival for the active waypoint.

8 Position Fuel (POS FUEL)

Displays FMC calculated fuel remaining at the POS waypoint.

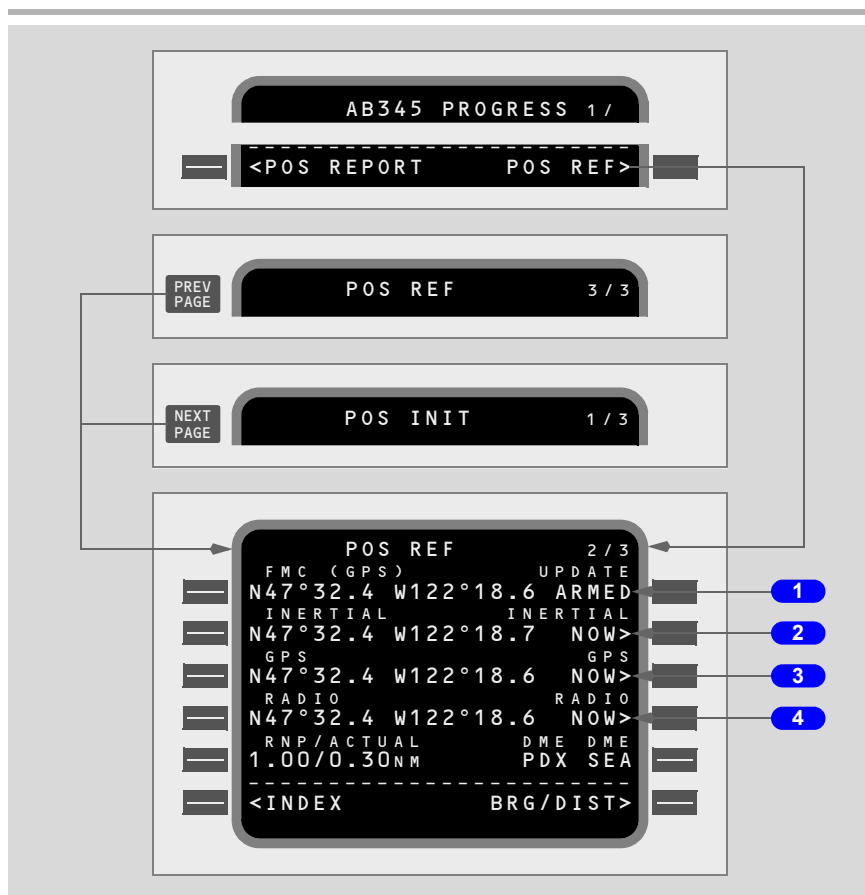
9 REPORT

Push – transmits a data link downlink of the data on this page.

The data link transmission of a position report requires the data link option be enabled, operational, and not in the voice or no-communications mode.

In-Flight Position Update

FMC position update can be accomplished on the POS REF 2/3 page in flight.



1 UPDATE ARMED

Pushing the ARM prompt arms the position update function. ARM changes to ARMED. Each of the position update sources have a NOW prompt.

2 INERTIAL NOW

Push – to update the FMC position from the inertial position.

3 GPS NOW

Push – to update the FMC position from the GPS position.

4 RADIO NOW

Push – to update the FMC position from the navigation radio position.

Progress Pages

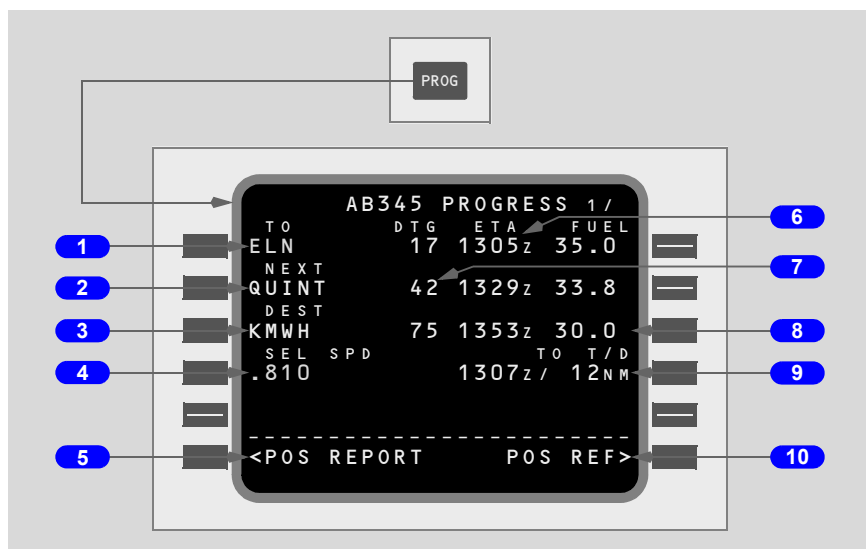
Progress Page 1

The progress page displays general flight progress data. The FMC Communication section of Chapter 5, Communications describes position reports.

The page title displays the company flight number entered on the RTE page.

Page one of the progress pages displays general data about:

- waypoints (active and next)
- destination data
- FMC speed
- T/C, T/D, etc.



1 TO

Active waypoint displays in magenta.

Can not be modified.

2 NEXT

Waypoint after TO waypoint displays in white.

Can not be modified

3 Destination (DEST)

Any waypoint or airport in navigation database can be entered. The line titles are:

- DEST – performance predictions to destination. Default display
- DIR TO FIX – when entered waypoint is not in flight plan. Data is based on flying present position direct to the waypoint
- EN ROUTE WPT – when entered waypoint is in flight plan. Line data are based on flying the flight plan route to the waypoint
- MOD – a modification has been made on another page. Performance predictions include modification.

Remove entries with DELETE key or change all CDUs to a different page.

4 Selected Speed (SEL SPD)

The FMC active command speed displays in magenta.

The active speed mode is the same as on the performance page, unless changed by the MCP or a limit. The speed modes are:

- ECON SPD – economy speed
- LRC SPD – long range cruise speed
- SEL SPD – selected speed manually entered on the CDU
- EO SPD – engine out speed
- CO SPD – engine out operations at airline specified engine out company speed
- LIM SPD – speed is limited by VMO, MMO, flap limit, or buffet limit
- MCP SPD – MCP speed entered on the MCP IAS/MACH indicator
- VREF +80 – for engine out operations during takeoff
- RTA SPD – RTA speed is active

5 Position Report (POS REPORT)

Push – displays the POS REPORT page.

6 ETA

Estimated time of arrival at waypoint or destination.

7 Distance To Go (DTG)

Distance to go to waypoint or destination.

8 FUEL

Estimated fuel remaining at waypoint or destination.

9 TO T/D

Data line displays ETA and DTG to line title point.

Data line displays NOW when the airplane is past the climb/descent point when STEP CLB or T/D displays in the line title.

Data line displays NONE when the line title is STEP CLB and the step has not been entered on the CRZ page or the FMC calculates a step climb is not advised.

Line titles are:

- T/C - top of climb
- STEP CLB – step climb data
- T/D – top of descent data
- E/D – end of descent data
- LEVEL AT – time and distance to level off in Drift Down mode.

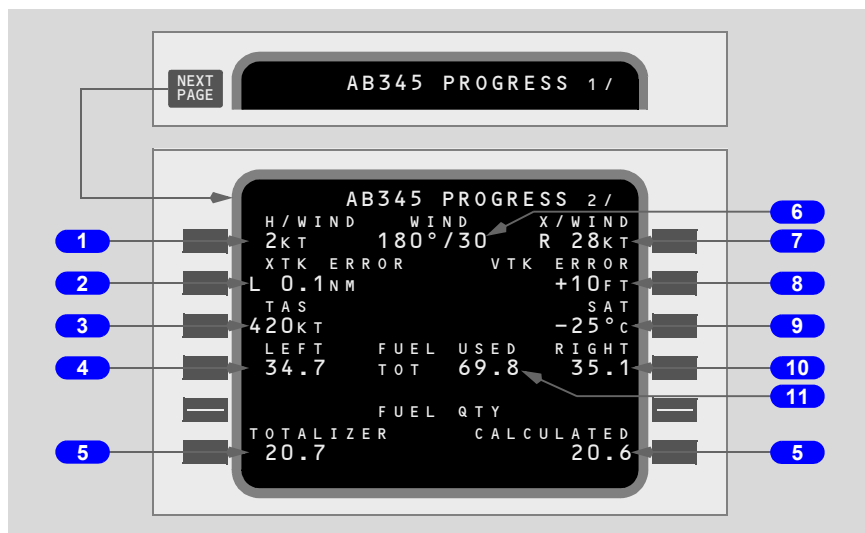
10 Position Reference (POS REF)

Push – displays position reference page.

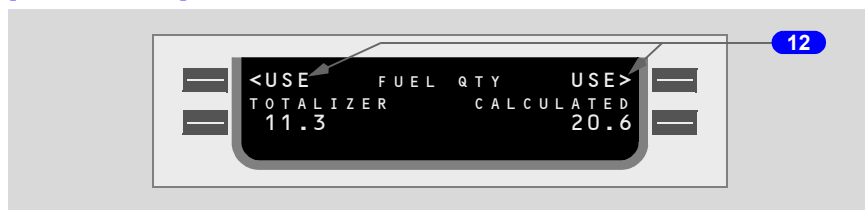
Progress Page 2

Progress page two contains:

- wind data
- fuel data
- static air temperature
- true airspeed
- track error data.



[After AIMS 05]



1 Headwind (H/WIND), Tailwind (T/WIND)

Displays headwind (H/WIND) or tailwind (T/WIND) component.

Wind component data is relative to the airplane.

2 Crosstrack Error (XTK ERROR)

Displays crosstrack (XTK) error in nautical miles left or right of the active route.

3 TAS

Displays airplane true airspeed.

4 LEFT FUEL USED

Displays fuel used by left engine sensed by fuel flow meters.

5 Fuel Quantity TOTALIZER, CALCULATED

The fuel remaining line displays two independent fuel quantities, TOTALIZER and CALCULATED. TOTALIZER is the totalizer system fuel quantity. It is blank if the fuel quantity is manually entered on the PERF INIT page; the manually entered quantity displays under CALCULATED and the fuel quantity indicating system is not used until flight completion.

[Option - GE engines]

When no manual fuel quantity entry is made on the PERF INIT page, CALCULATED displays the FMC calculated fuel quantity remaining. Before engine start, the CALCULATED value is set equal to the TOTALIZER. The displayed totalizer quantity can be between 99% and 101% of the actual fuel. After engine start, the CALCULATED fuel quantity is decreased by the fuel flow sensing system (FUEL USED). Sensed fuel flow tolerances may allow up to 88 lbs (or 40 kgs) per hour CALCULATED fuel quantity variation.

[Option - PW or RR engines]

When no manual fuel quantity entry is made on the PERF INIT page, CALCULATED displays the FMC calculated fuel quantity remaining. Before engine start, the CALCULATED value is set equal to the TOTALIZER. The displayed totalizer quantity can be between 99% and 101% of the actual fuel. After engine start, the CALCULATED fuel quantity is decreased by the fuel flow sensing system (FUEL USED). Sensed fuel flow tolerances may allow up to 161 lbs (or 73 kgs) per hour CALCULATED fuel quantity variation.

After fuel jettison or after all engines are shut down, CALCULATED resets to the totalizer system fuel quantity.

6 WIND

Displays current wind direction and speed referenced to true north.

7 Crosswind (X/WIND)

Displays left (L) or right (R) crosswind component relative to airplane heading.

8 Vertical Track Error (VTK ERROR)

Displays vertical path (VTK) error above (+) or below (-) vertical path.

9 Static Air Temperature (SAT)

Displays outside static air temperature.

10 RIGHT FUEL USED

Displays fuel used by right engine sensed by fuel flow meters.

11 FUEL USED Total (TOT)

Displays sum of the LEFT and RIGHT fuel used values.

12 USE

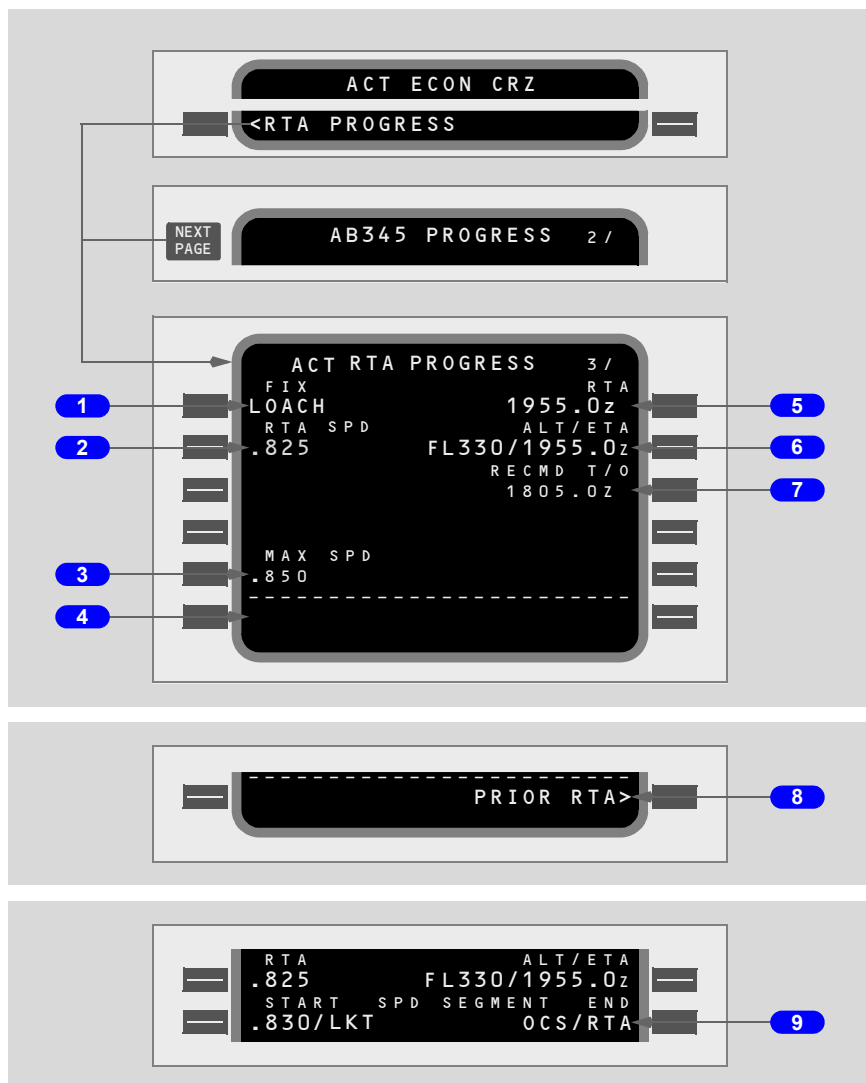
Push – selects method to calculate fuel quantity, either TOTALIZER or CALCULATED.

When one is selected:

- it is used for remainder of flight
- the other fuel calculation method blanks
- scratchpad clears.

RTA Progress Page 3

Progress page three is used to enter data for required time of arrival (RTA). RTA can be entered or changed during preflight or in flight. Creating an RTA changes CRZ page title to RTA CRZ. RTA operates only in cruise.



1 FIX

Valid entry is a waypoint in the active or pending active route. Waypoints defined by coordinates must be down selected to the scratchpad, then selected to the FIX line.

Entry by flight crew or data link.

Entry displays boxes in 1R and RTA in the line title and ALT/ETA in 2R line title.

When RTA active, deletion of FIX terminates RTA and resumes ECON. Display returns to boxes.

When RTA not active, deletion of FIX erases a pending RTA MOD. Display returns to boxes.

Displays boxes when an active or modified route exists.

Displays blank if engine out has been selected.

2 Required Time Of Arrival Speed (RTA SPD)

Displays FMC computed cruise speed to accomplish RTA.

Displays blank if no RTA fix or time entered.

3 Maximum Speed (MAX SPD)

Valid entry is Mach .100 to .990; displays in large font.

Deletion of entered value displays default Mach .850 in small font.

4 Displays ERASE when modification pending

Push - displays previous unmodified page, or if no previous active values, deletes RTA in 1R.

5 Required Time Of Arrival (RTA)

Boxes display after entry of RTA FIX in 1L.

Valid entry is time from 0000.0 to 2359.9. Decimal entry of .0 is optional.

Suffix to RTA indicates:

- no suffix – arrive at entered time
- A – arrive at or after entered time
- B – arrive at or before entered time.

Entry before takeoff causes recommended T/O time to display in small font.

Deletion terminates RTA and returns ECON as cruise mode.

6 Altitude/ETA (ALT/ETA)

Displays predicted altitude and ETA at RTA fix after entry of FIX in 1L.

Blank until performance data is entered.

7 Recommended Takeoff (RECMD T/O)

Displays recommended takeoff time to meet RTA at ECON speed.

Dashes until FIX is entered.

Blanks in flight.

Valid entry is time from 0000.0 to 2359.9. Decimal entry of .0 is optional.

Manual entry recalculates all flight plan time predictions.

Changes to NOW after recommended takeoff time.

8 PRIOR RTA

Displays when prior RTA fix and time exists.

Push -

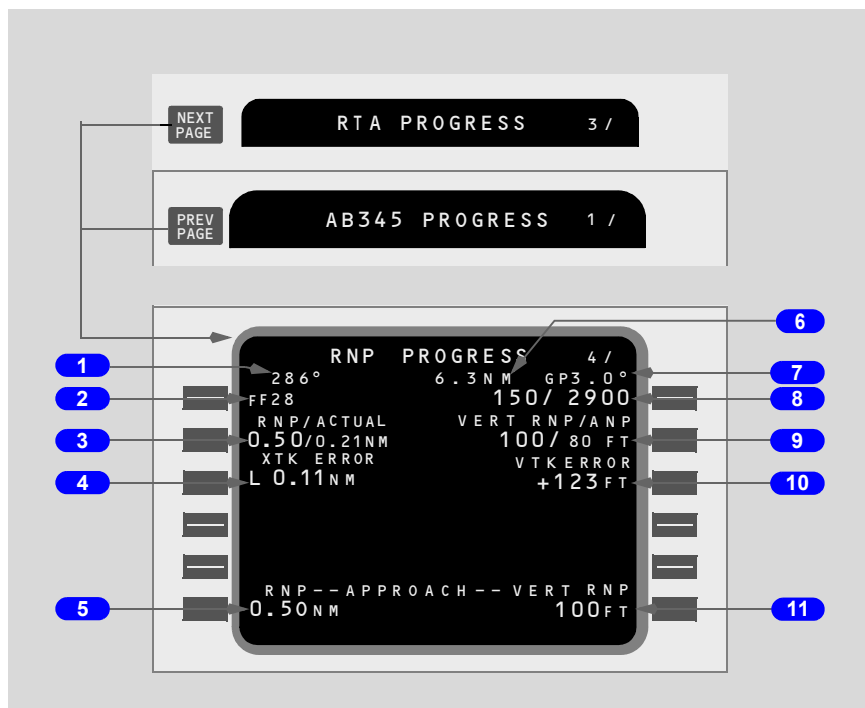
- displays previous RTA fix and time
- initiates RTA flight plan modification.

9 Cruise Speed Segment

Displays cruise speed segment start and end waypoints.

RNP Progress Page 4

Progress page four displays concise RNP information. Some of the information on page 2 has been repeated to display all related RNP information together.



1 Leg Direction

Leg segment data in line title:

- courses – magnetic (xxx°) or true (xxx° T)
- arcs – distance in miles, ARC, turn direction (example: 24 ARC L)
- heading leg segments – xxx° HDG
- track leg segments – xxx° TRK
- special procedural instructions from database - HOLD AT, PROC TURN, or PROC HOLD (FMC exits hold when crossing the fix after entry).

Calculated great circle route leg directions may be different than chart values.

Dashes display for an undefined course.

2 Waypoint Identifier

Displays the next waypoint.

3 Required Navigation Performance and Actual Navigation Performance (RNP /ACTUAL)

Display same as 5L POS REF 2/3. Manual entry displays in large font; propagated to 5L POS REF 2/3 page.

4 Crosstrack Error (XTK ERROR)

Displays present crosstrack error from the desired LNAV course. L or R indicates left or right of course. Blank if error is greater than 99.9 NM.

5 Lateral RNP (Approach)

Displays lowest applicable RNP for the approach. Entry not allowed at 6L.

Manual entry at 3L displays in large font.

RNP values from the navigation database display in small font; or, if there are none, displays the default value for the approach navigation flight phase stored in the FMC.

6 Distance To Go

Displays the distance remaining to the next waypoint.

7 Glidepath

Displays the FMC computed glidepath for the approach.

8 Waypoint Speed/Altitude

Displays waypoint speed or altitude constraints in large font. Displays FMC predicted value in small font when no restrictions have been specified.

9 Vertical Navigation Performance

Displays both vertical RNP and ANP for the current leg.

Valid display range for vertical ANP is 0 to 999 feet.

Manual entries are allowed and display in large font.

Valid entries are 10 to 999 feet and may be suffixed with an optional "/".

Entries clear at flight completion.

Values from the navigation database display in small font.

10 Vertical Error (VTK ERROR)

Displays present vertical error from the FMC computed glidepath.

11 Vertical RNP (Approach)

Displays the lowest applicable vertical RNP for the approach.

Manual entries (entered in 2R) display in large font.

Values from the navigation database display in small font.

Flight Management, Navigation
FMC Descent and Approach**Chapter 11**
Section 43

Introduction

The descent phase starts at the top of descent point and continues to the end of descent point. Planning for the descent phase starts during cruise.

The approach phase starts when the airplane is in the descent phase and flaps are out of up. In general, the approach starts no later than sequencing the final approach fix. For a detailed explanation of “on approach” refer to Chapter 11.31.

Alternates are available from preflight through approach phase of flight and can be selected or updated at any time. Diversion to an alternate can be accomplished during all phases of flight.

The only automatic page change in the descent/approach phases is the VNAV selected page change from cruise to descent at the top of descent.

Early Descent

Early descents are discussed in Section 42, FMC Cruise.

Descent

During descent, LNAV is managed using the RTE LEGS and PROGRESS pages, as in the cruise phase. VNAV descent management is accomplished primarily on the DES page.

During descent, the specific page listed below is used to:

- DESCENT FORECAST page – enter forecast wind data to aid descent planning
- OFFPATH DES page – analyze descent performance with and without the use of speedbrakes
- ALTN page – manage the selection of alternate airports and diversions

Altitude Intervention

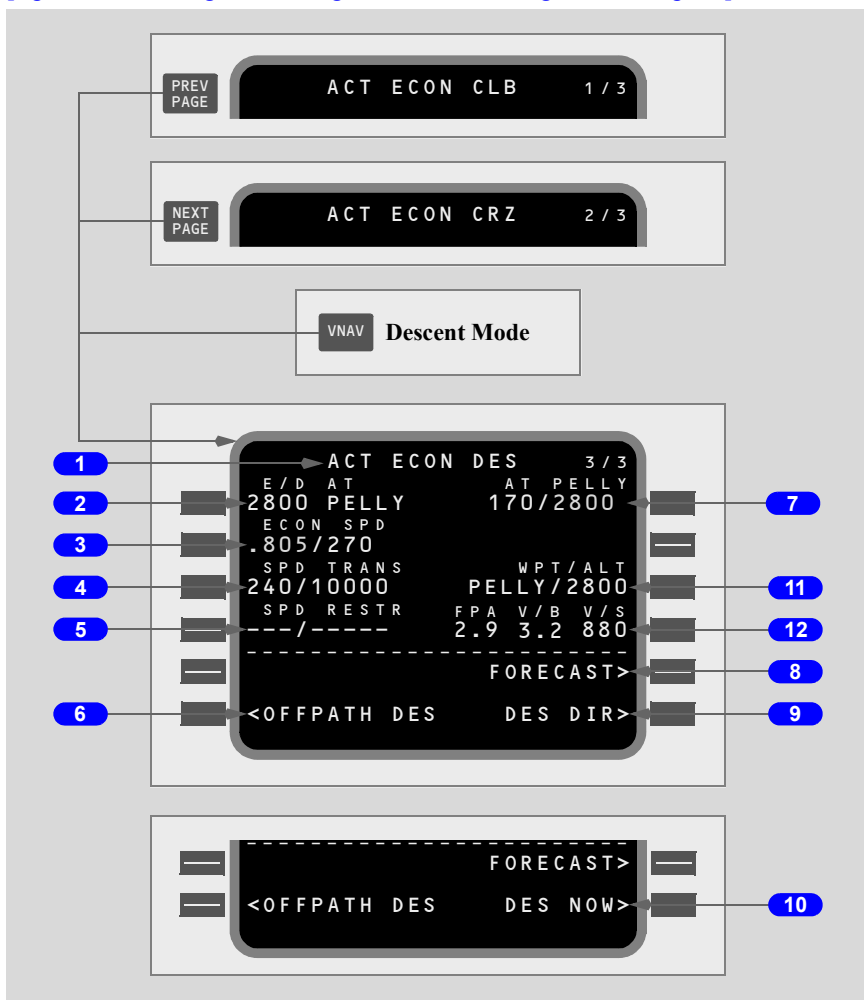
If an unplanned level-off is required, setting the altitude window to the required altitude causes the airplane to level at the set altitude. VNAV PTH changes to VNAV ALT. The descent can be continued by setting the altitude window to a lower altitude and pushing the altitude selector. If the altitude window is set to an altitude below other altitude constraints, each altitude constraint can be deleted by each push of the altitude selector. Or, all waypoint altitude constraints between the current airplane altitude and the altitude window setting can be deleted by selection of the DES DIR> prompt on the DES page.

Descent Page

The descent page is used to monitor and revise the descent path. Descent speeds are economy (ECON) and fixed speed (SEL). The default VNAV descent mode is ECON. A fixed speed descent is flown when speed intervention is used or a speed is entered on the DES page. The descent page is blank with DES as the title until an altitude constraint below the cruise altitude is entered.

This page title includes the VNAV speed mode. The ECON mode controls descent speed at the economy speed until reaching a lower speed restriction. The fixed speed mode controls descent speed at the fixed speed until a lower speed restriction is reached.

[Option Adds - Flight Path Angle, Vertical Bearing, Vertical Speed]



1 Page Title

The page title displays active (ACT) or modified (MOD) descent. Usually, the title displays ECON for economy descent. Fixed speed descents modify the title.

The page title displays the type of descent:

- ECON – speed based on a cost index
- LIM SPD – speed based on airplane configuration limiting speed
- MCP SPD – MCP speed intervention is selected
- XXXKT – fixed CAS descent speed profile

- M.XXX – fixed Mach descent speed profile
- END OF DES – E/D AT waypoint reached if not followed by a climb segment.

Fixed descent speeds are for:

- a flight crew entered selected speed (SEL SPD)
- a speed transition
- a speed restriction associated with an altitude constraint
- waypoint speed constraints

2 End Of Descent At (E/D AT)

Displays the end of descent altitude and waypoint.

The end of descent point is a waypoint in the descent phase with the lowest altitude constraint.

The altitude displays in magenta when altitude becomes the FMC altitude target.

Page is blank if no E/D point exists.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

Both CAS and Mach values display.

ECON SPD –

- economy speed based on cost index
- displays CAS and Mach values.

SEL SPD –

- displays when flight crew enters speed
- displays constraint speed on transitioning into a selected speed segment (waypoint speed constraint, SPD RESTR, or SPD TRANS)
- valid entries are CAS or Mach

The FMC commanded speed is magenta. Initially, Mach is magenta and CAS is white. Below CAS/Mach transition altitude, CAS is magenta and Mach is white.

4 Speed Transition (SPD TRANS)

The transition speed is usually 10 knots less than the destination airport limiting speed from the navigation database. When no airport limit speed exists, the default speed of 240 knots displays. The transition altitude is the point the transition speed is active for the destination airport. When no altitude exists in the navigation database, the default of 10,000 feet displays.

Speed displays in magenta when it is the FMC speed target.

Blanks below SPD TRANS altitude.

Deleting causes the airplane to fly economy or selected speed if not limited by a waypoint constraint or speed restriction.

5 Speed Restriction (SPD RESTR)

Speed restrictions at altitudes higher than E/D altitude and not associated with specific waypoints are manually entered on this line.

Valid entry is a CAS and altitude (example 240/8000). Entry may be deleted.

Magenta when it is FMC command speed.

6 Off Path Descent (OFFPATH DES)

Push – displays the OFFPATH DES page.

7 AT XXXXX

Displays the next waypoint constraint from the RTE LEGS page.

XXXX is:

- the waypoint identifier
- HOLD AT XXXXX
- AT VECTORS
- AT (INTC)

The constraint is speed/altitude. Blank when no constraint exists.

Can be deleted on this page.

VNAV commands the lesser of constraint speed or present performance speed.

Speed and/or altitude display in magenta when they are the FMC target values.

8 FORECAST

Push – displays the DESCENT FORECAST page.

9 Descend Direct (DES DIR)

Push – deletes all waypoint altitude constraints between the airplane altitude and the MCP altitude. FMC cruise altitude is not affected.

Displays in descent phase with altitude constraint between airplane and E/D.

10 Descend Now (DES NOW)

Push –

- starts a 1250 feet per minute descent schedule until intercepting the planned descent path
- activates the FMC descent phase

Displays when the descent phase is not active.

11 Waypoint/Altitude (WPT/ALT)

Line title appears at all times. Data line displays “-----/-----” when a descent profile does not exist in the flight plan. With a descent profile in the flight plan, data line displays the same waypoint/altitude restriction displayed on the AT line (1R). When sequencing the displayed waypoint, the next waypoint, and altitude in the descent profile display. This waypoint may be overwritten by pilot entry. Valid entry is any pilot defined waypoint in the flight plan (e.g. LMT02, PAE53) or any waypoint, navaid, or airport in the navigation database.

12 Flight Path Angle, Vertical Bearing, and Vertical Speed (FPA, V/B, V/S)

- FPA - displays the current airplane flight path angle whenever the airplane descends (data blanks if the airplane levels or climbs).
- V/B - displays vertical bearing from current position to the displayed waypoint and altitude (data blank if WPT/ALT line displays “-----/-----”).
- V/S - displays required vertical speed to maintain the vertical bearing (data blank if WPT/ALT line displays “-----/-----”)

Descent Forecast Page

The descent forecast page is used to enter wind data for descent, and the altitude at which anti-ice use is anticipated for more accurate descent path calculation.

The primary entries are wind direction and speed for up to four descent altitudes, and the altitude that anti-ice is turned on.



1 Transition Level (TRANS LVL)

Displays the transition level.

The transition level can be specified by the arrival procedure. The default transition level is FL 180.

Above transition level, altitudes are in flight levels. Below transition level, altitudes are in thousands of feet.

Valid entry is an altitude or flight level.

2 Altitude (ALT)

Enter altitude of forecast wind data.

Altitudes and flight levels can be entered in any order. Entries are not sorted.

Execute not necessary.

3 FORECAST REQUEST

Push – transmits a data link request for descent wind data.

4 Thermal Anti-Ice On Altitude (TAI/ON ALT)

Enter the altitude where anti-ice is first turned on during the descent.

5 Wind Direction/Speed (WIND DIR/SPD)

Enter the wind direction/speed for the specified altitude. Initial entry must have wind direction and speed, subsequent entries may have one or the other.

Execute not necessary.

6 Descent (DES)

Push – displays the DES page.

Offpath Descent Page

The offpath descent page allows the analysis of descent performance off the present route of flight, direct to a selected waypoint. Data entered on the page shows clean and drag descent ranges on the page and on the ND. The ranges are based on an entered waypoint and altitude constraint. The range can be used to determine if the altitude constraint can be met in a direct descent to the waypoint.

The FMC puts the last descent waypoint with an altitude constraint into DES TO.

The ECON SPD, SPD TRANS, SPD RESTR, and DES data are the same as the DES page.

The diagram illustrates the Offpath Descent (OFFPATH DES) page layout. It features a top header bar with 'ACT ECON DES' and '3 / 3'. Below this is a sub-header bar with '<OFFPATH DES' and 'DES DIR>'. The main display area is divided into two columns. The left column contains the following text: 'DES TO PELLY', 'ECON SPD .805/270', 'SPD TRANS 240/10000', 'SPD RESTR ---/---', and '<DES'. The right column contains: 'DTG 150', 'SPD/ALT 170/2800', 'TO CLEAN -13NM', and 'TO DRAG 89NM'. At the bottom right, there is a 'DISPLAY OFF <> ON' indicator. Numbered callouts point to specific elements: 1 points to the left side of the main display area; 2 points to the top right of the main display area; 3 points to the 'SPD/ALT' line; 4 points to the 'TO CLEAN' line; 5 points to the 'TO DRAG' line; and 6 points to the 'DISPLAY OFF <> ON' indicator.

1 Descend To (DES TO)

The waypoint for a direct-to descent. Usually, this is the E/D waypoint from the active route. Manual entry of waypoints on or off of the route are allowed. The DTG calculations are for a descent direct to the selected waypoint.

When within 150 feet of the DES TO altitude for a waypoint other than the E/D waypoint, the display automatically changes the DES TO waypoint to the E/D waypoint from the DES page.

A waypoint is entered for direct-to analysis.

2 Distance To Go (DTG)

Displays the straight line distance to the entered waypoint.

3 Speed/Altitude (SPD/ALT)

Displays the speed/altitude constraint for the entered waypoint.

A manual waypoint entry displays boxes for manual speed and altitude entry.

4 TO CLEAN

Distance to the clean descent circle. The distance is negative when a clean descent is no longer possible.

A clean circle assumes no drag devices are used for descent.

A direct descent to the DES TO waypoint at a SPD/ALT constraint is possible when the airplane is outside the clean circle. The clean circle displays on the ND when the DISPLAY prompt is ON.

5 TO DRAG

Distance to the drag descent circle. The distance is negative when a drag descent is no longer possible.

A drag circle assumes speedbrakes are UP for descent.

A direct descent to the DES TO waypoint at a SPD/ALT constraint is possible when the airplane is outside the drag circle. The drag circle displays on the ND when the DISPLAY prompt is ON and the airplane is inside the clean circle.

6 DISPLAY

Push – alternates between ON and OFF.

ON – displays the clean and drag circles on the ND. The drag circle does not display until the airplane position is inside the clean circle.

OFF – removes the clean and drag circles from the ND.

Selected state is large green font, otherwise small white font.

Automatically changes to OFF within 150 feet of the waypoint constraint altitude.

Engine Out Descent

There are no specific engine out pages for descent. Use the two engine descent planning features and pages.

Approach

During approach, roll and pitch modes usually change to the approach guidance supplied by navigation radios. The FMC continues to calculate and show present position and can supply LNAV and VNAV approach guidance for certain types of approaches when radio navigation is not used.

The RTE LEGS and PROGRESS pages are used to manage the airplane until other approach guidance becomes active. Other pages which support approaches are:

- ARRIVALS page – to select arrival and approach procedures
- APPROACH REF page – to specify approach flap settings and set the approach VREF
- HOLD page – to manage holding patterns

Holding is described in this section but it can be used during any phase of flight.

Accessing the arrivals page more than 400 NM from the departure airport, more than halfway along the active route, beyond the top of climb and within two minutes of top of descent, or beyond the top of descent, displays arrivals for the destination airport. Prior to these points, accessing the arrivals page displays arrivals for the departure airport.

Sequencing any of the above points also causes the FMC to send landing altitude data to the cabin altitude controller. Until an arrival approach has been selected into the active flight plan, the destination airport altitude is used by the cabin altitude controller.

Arrivals Page

The arrivals page allows selection of a runway, approach, approach transition, standard terminal arrival route (STAR) or profile descent, and an arrival transition to the destination airport. The INDEX key accesses the DEP/ARR INDEX and provides arrival/departure data for any other airport in the navigation database. Route 1 and route 2 have separate arrival pages.

Airports are using multiple RNAV/ILS approaches to the same runway. ICAO has developed a naming convention which adds an additional character to the approach name; Z, Y, X, ... in the approach title following the guidance source. The primary approach is identified as the “Z” approach; all subsequent procedures (normally with different missed approach paths) use the alpha characters in reverse order beginning with Y. This change requires approach names with up to eight characters, rather than the current maximum of six, to be encoded in the navigation database.

Selecting Options

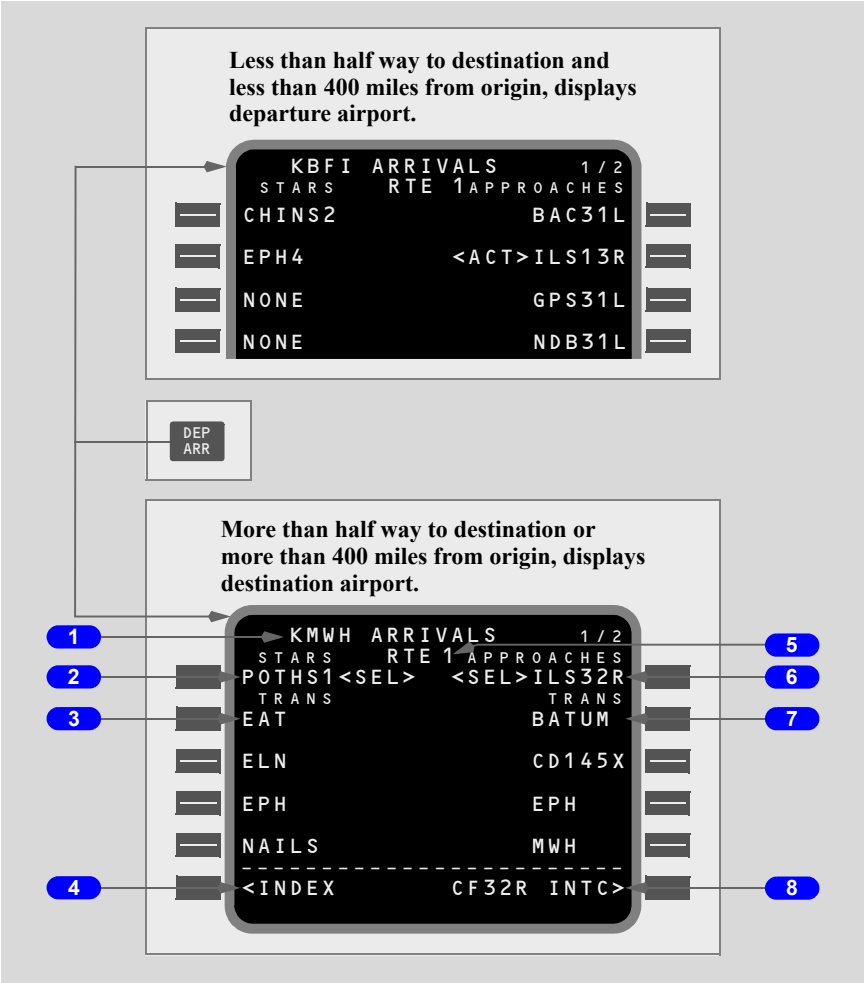
Selecting a runway, approach, approach transition, STAR/profile descent, or arrival transition displays <SEL> inboard of the selection and displays MOD in the page title. The other options within the same category are removed from the list. When the modification is executed, <SEL> changes to <ACT>. Selecting another page and returning to ARRIVALS displays all options; the applicable <SEL> or <ACT> prompts display.

When a STAR is selected followed by selection of an approach or runway and a transition exists in the navigation database, the transition waypoints with associated speed/altitude constraints are inserted into the flight plan linking the STAR to the approach or runway. If more than one transition exists, selection of the applicable transition is made under TRANS on the left side of the page. Some STARs serve more than one runway. If a STAR and runway are selected and subsequently a different runway is selected, and if the STAR is compatible with the new runway, the transition waypoints are inserted into the flight plan linking the STAR to the runway.

If a different STAR, runway, or STAR-runway combination is desired, selecting another page and returning to the ARRIVALS displays all options.

Arrivals Page – IFR Approaches

[Options shown: NDB and GPS Approaches]



1 Page Title

The destination airport identifier displays in the title.
Airports with more than 5 runways or STARS produce multiple arrivals pages.

2 Standard Terminal Arrivals (STARS), Profile Descents (PROF DES)

STARS display in a list under the STAR line title. Profile descents display below STARS under the PROF DES line title.

NONE displays when no STARS in the database.

Push -

- selects STAR or PROF DES for entry into the route, <SEL> displays
- all other arrival procedures no longer display and transitions for the selected procedure display
- deletes a previously selected procedure
- displays ERASE prompt

3 STAR Transitions (TRANS)

Displays list of transitions for the selected arrival procedure.

Push -

- selects transition for entry into the route
- all other transitions no longer display

4 INDEX

Push – displays the DEP/ARR INDEX page.

5 Route 1 (RTE 1)

Displays the active route number (RTE 1 or RTE 2).

6 APPROACHES

Displays the destination airport approaches.

Selection and execution of an ILS approach autotunes the ILS receivers and displays the course. Selection and execution of a back course (BAC) approach autotunes the ILS and displays the front course. BAC approaches cannot be flown in the MCP LOC or APP mode.

Push -

- selects approach for entry into the route; <SEL> displays; TRANS replaces RUNWAYS
- displays profile descents for the selected approach; deletes all other approaches and runways
- displays INTC prompt for the selected approach
- displays ERASE prompt

7 Approach Transitions (TRANS)

Displays a list of transitions to the selected approach.

Approach transitions include IAFs, feeder fixes, and fixes providing routing to the FAF.

When transition not selected, approach will be a straight-in approach starting at a waypoint 4 to 8 miles outside the FAF. Waypoint may be a charted fix or CFXXX (XXX is the runway number).

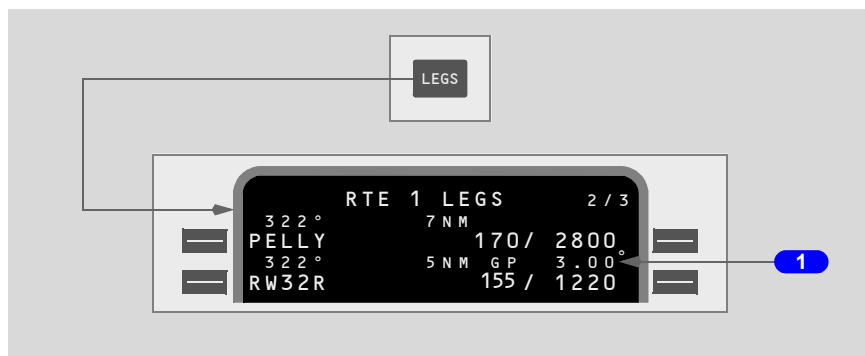
Push –

- selects transition for entry into the route
- deletes all other transitions
- displays INTC prompt for selected transition

8 Final Approach Fix Intercept (XXXXX INTC)

Selecting the prompt displays a modified RTE LEGS page with an intercept course to the approach transition fix (usually the IAF) for the selected approach.

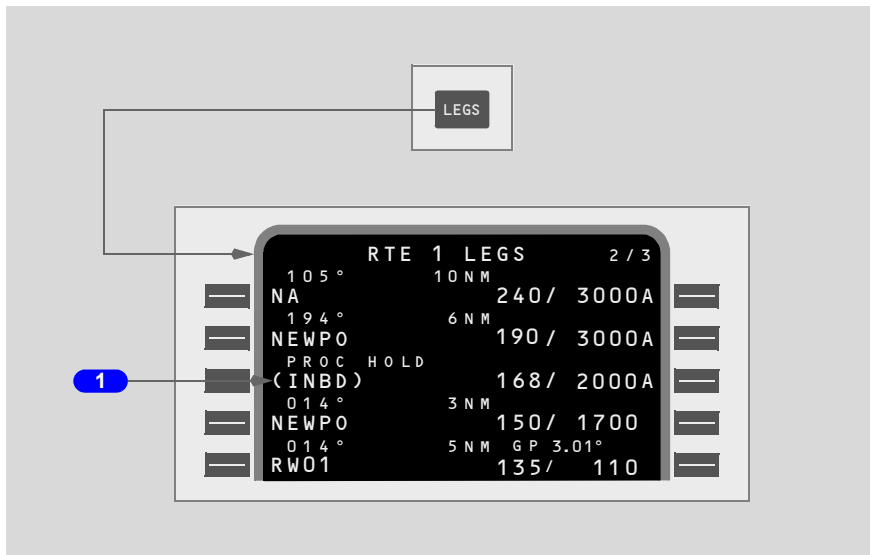
Arrivals Legs Page



1 Glide Path Display

Displays the glide path angle used by VNAV on final approach to the runway. If the runway was selected as part of a published approach, the displayed angle will be close to the published glide path angle, but may differ slightly.

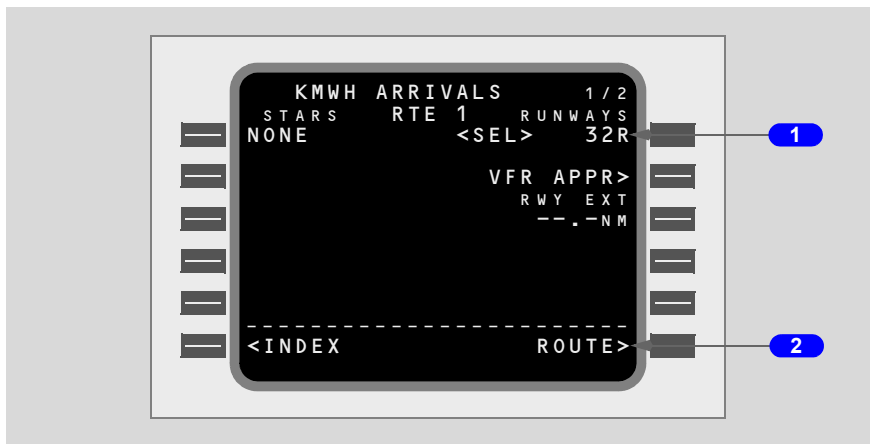
Procedure Hold (in lieu of procedure turn) Legs Page

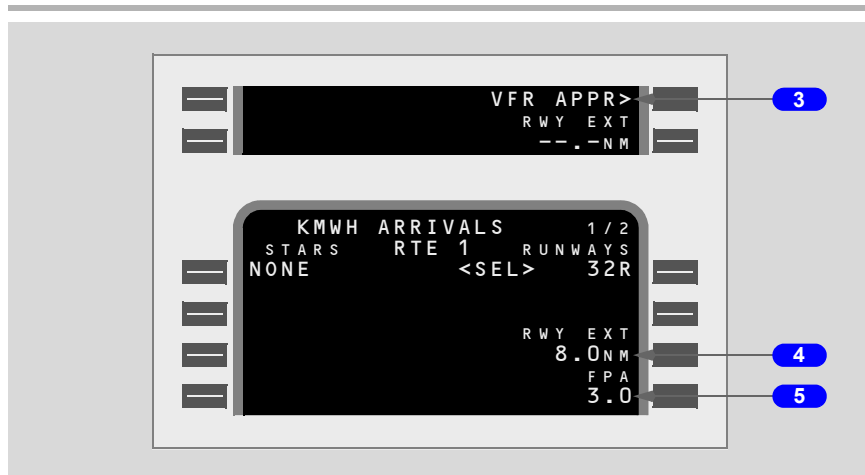


1 Inbound Waypoint

A conditional waypoint (“INBD”) is created at the end of the procedure turn. This waypoint displays on the ND as a small circle. The next line displays inbound heading and distance to the holding fix. The procedure hold is not displayed on a Hold page.

Arrivals Page – VFR Approaches





1 RUNWAYS

Displays a list of runways for destination airport.

Push –

- selects runway for entry into the route
- deletes previously selected approach
- allows selection of VFR approach or entry of RWY EXT data
- deletes all other runways and approaches
- displays approach intercept fix for selected runway

2 ROUTE

Push – displays the active route page 2/X.

3 VFR Approach (VFR APPR)

Push – makes a transition waypoint, FAXXX at 8 NM and 2000 feet above the runway.

Displays when a VFR approach is in navigation data base for selected runway.

LNAV and VNAV guidance to the runway is available. VNAV programs arrival at the FAF at 170 knots.

4 Runway Extension (RWY EXT)

After VFR APPR selected, displays RWY EXT 8.0; RWY EXT can not be modified.

5 Flight Path Angle (FPA)

Displays flight path angle. Displays only after VFR APPR is selected.

Default is 3.0 degrees. Valid entries are from 2.4 to 3.7 degrees.

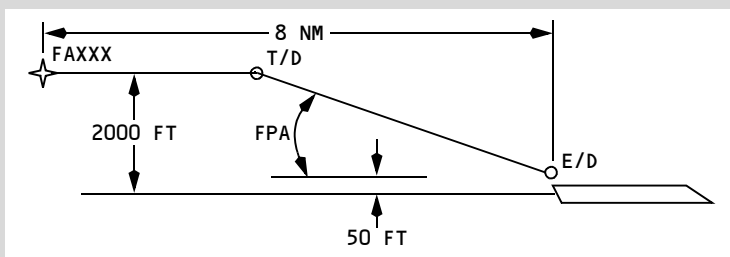
6 Runway Extension (RWY EXT)

Valid entries are from 1.0 to 25.0 miles from the runway threshold.

Entry allowed if VFR APPR is not selected. Entry removes VFR APPR prompt. Example shows 6 NM entered.

Makes waypoint RXYYY, where YYY is the runway; example: RX32R. Makes a route discontinuity before and after the waypoint.

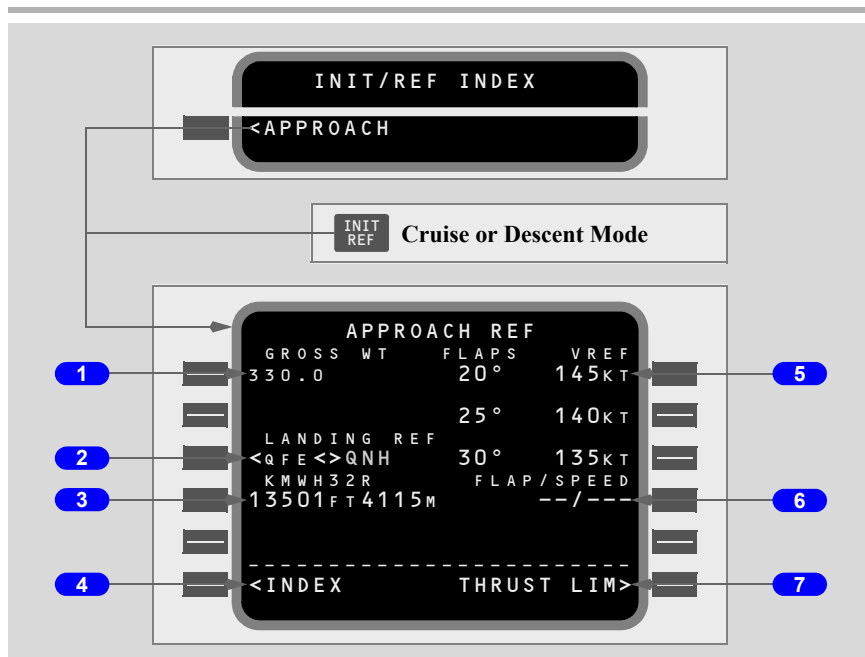
VFR Approach Path



The VFR approach is a level path until the VNAV descent path is intercepted. The descent path begins at the FAXXX waypoint altitude and terminates at the runway threshold at 50 feet. Default values display in RWY EXT and FPA.

Approach Reference Page

The approach reference page displays approach planning data and approach reference speed (VREF) selection.



1 Gross Weight (GROSS WT)

FMC calculated airplane gross weight usually displays.

Manual entry is allowed in case the FMC calculated gross weight is unavailable or invalid, or to allow previewing recommended approach speeds at other than the calculated FMC gross weight. The manually entered gross weight will become the FMC calculated gross weight when a different page is selected and the APPROACH REF page is reselected. Permanent changes to gross weight result in recalculation of all performance data and may only be made on the PERF INIT page.

Displays boxes when gross weight is not available from the FMC.

Valid entry is XXX.X.

2 Landing Reference (LANDING REF)

Landing reference is selectable between QNH and QFE. Usually, QNH is the operating mode.

Selecting QFE sets the cabin pressurization schedule, and the destination landing altitude indication to zero altitude. With the landing reference set to QFE, changing the barometric setting from STD to QFE changes the PFD altitude tape background color to green. With QFE selected and climb phase active, changing the barometric setting from QFE to STD causes the landing reference to toggle from QFE to QNH and the green background color is removed.

For QFE operations, refer to Supplementary Procedures, Flight Instruments, Displays.

Toggles between QFE and QNH. The active mode displays in large green font. The inactive mode displays in small white font.

3 Runway Length

The displayed runway reference changes based on route progress. The destination runway is the reference when the present position is more that halfway to the destination or more than 400 NM from the origin airport. The origin airport runway is the reference when less than halfway or less than 400 NM from the origin airport.

Displays the length in feet and meters of the referenced runway.

4 INDEX

Push – displays the INT/REF INDEX page.

5 FLAPS VREF

A gross weight is necessary for VREF speed calculation. Push the applicable line select key to select the correct VREF speed. The three VREF speeds are based on landing flap setting.

Displays the calculated reference speed for flaps 20°, 25°, and 30°.

The display is blank until a gross weight is displayed.

6 FLAP/SPEED

The flap position and VREF speed is entered for landing.

The VREF speed displays on the PFD.

Deletion of the data removes VREF from the PFD.

7 Thrust Limit (THRUST LIM)

Push – displays the THRUST LIM page.

Alternate Airport Diversions

ALTN page 1/2 data aids the flight crew in finding a suitable alternate airport. The page displays four airports in an ETA sequence. Each airport on the list has an XXXX ALTN page with more data. Select the XXXX ALTN page with a caret. ALTN LIST page 2/2 may contain a list of uplinked alternate airports.

Three alternate airport uplinks can be received. ALTN LIST page 1/2 can get an uplink for the entire page or for just the ALTN INHIB line. ALTN LIST page 2/2 can receive an uplink of alternate airport names.

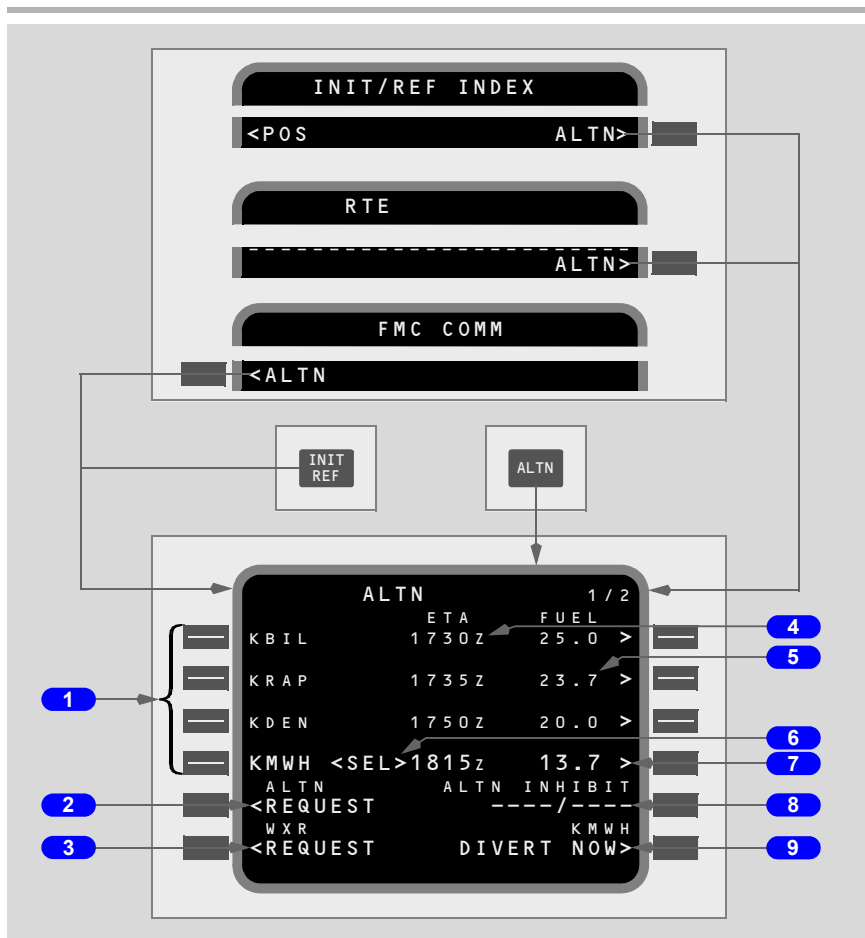
Alternate Page 1/2

The first alternate page displays alternate airport data. An alternate airport can be selected to change the flight plan destination.

The source of alternate airports can be:

- an uplink directly to this page
- automatic selection from the ALTN LIST page
- automatic selection from the navigation database
- manual entry

Alternate airports automatically selected from the alternate list or the navigation database display in small font. All four alternates display on the ND in cyan. The alternate airport symbols display when the ND is in the plan mode. The selected alternate airport displays at all times on the ND map. Other alternates display on the ND when the ARPT switch is on.



1 Alternate Airports

Displays the identifier of the four alternate airports in ETA order in flight; and, in distance order on the ground.

Valid manual entry is an airport from the navigation database.

A manual entry into a field displaying a small font value overwrites the small font value, but does not delete it from the Alternates Candidates list. After predictions are complete, the overwritten small font value is placed on the list according to ETA order. A manual entry into a field displaying a large font value overwrites the large font value. Manual entries display in large font.

The DELETE function key can be used to remove manually entered alternate airports from the ALTN page.

2 Alternate Request (ALTN REQUEST)

Push – transmits a data link request for a preferred list of alternates (up to four).

Uplinked airports display in ETA order but are assigned a preference number by the transmitting site. The scratchpad displays the message ALTN UPLINK when the alternate airport data arrives.

3 Weather Request (WXR REQUEST)

Push – transmits a data link request for alternate airport weather data.

Uplinked weather is sent to the flight deck printer.

4 ETA

ETA is calculated based on the routing, altitude, and speed displayed on the XXXX ALTN page. ETA is blank when the airplane is on the ground.

Displays the alternate airport ETA.

Blank when airplane is on the ground.

5 FUEL

Predicted arrival fuel is calculated based on the routing, altitude, and speed displayed on the XXXX ALTN page. The message UNABLE FUEL displays in the FUEL column if the predicted arrival fuel is less than zero.

Fuel values are blank when the airplane is on the ground.

Displays the alternate airport predicted arrival fuel.

6 Selected (<SEL>)

The selected alternate is identified with an <A> or <SEL> to the right of the airport identifier. Usually, the closest alternate is selected and identified with <A>. Manually selecting an alternate places <SEL> to the right of the airport identifier. The selected alternate identifier displays in the line title of the DIVERT NOW prompt.

The FMC selects the alternate airport with the earliest ETA. FMC selected alternates display <A> to the right of the airport identifier.

Entering a new airport into the list of four does not select the new airport.

Use the DELETE function key on a manually selected alternate to remove <SEL>. The automatic selection function selects a new alternate.

7 Alternate Select

Push - displays the XXXX ALTN page for the alternate airport adjacent to the > prompt.

8 Alternate Inhibit (ALTN INHIBIT)

An airport will not be one of the four alternate airports if entered into the alternate inhibit line.

One or two airports can be entered.

Alternate inhibits can be manually entered or uplinked. The inhibited airports may be uplinked with the ALTN UPLINK or separately. If uplinked separately, the scratchpad displays the message ALTN INHIBIT UPLINK.

Valid entries are airports from the navigation database.

9 DIVERT NOW

Selecting DIVERT NOW displays the route from the present position to the selected alternate using the route displayed on the XXXX ALTN page for the diversion airport. The details of the route can be confirmed or modified before the diversion is executed.

Execution of the diversion:

- changes the route destination airport
- includes the route modification into the active flight plan
- deletes all parts of the original route that are not part of the diversion
- if a descent path exists, deletes all descent constraints (the scratchpad message DESCENT PATH DELETED displays when DIVERT NOW is selected)

After a divert is executed the XXXX ALTN page is not updated until all CDUs are selected off of the XXXX ALTN page.

Push –

- makes an LNAV route modification for a divert to the selected alternate
- displays the MOD XXXX ALTN page for the selected alternate
- displays SELECTED in place of DIVERT NOW
- blank on ground
- blank in the air when a diversion is not permitted

Alternate List Page 2/2

The second alternate page displays a list of previously uplinked alternate airports. The alternates on the ALTN 1/2 page are selected from this list or from the navigation database when a list does not exist.



1 Alternate Airports List

These four lines contain up to 20 airports from which alternates can be selected and displayed on ALTN page 1/2 when preferred uplinked airports do not use all four lines.

The list is uplinked directly to this page. No manual entry is allowed. Manual airport entries are accomplished on the ALTN 1/2 page.

2 Alternate List Request (ALTN LIST REQUEST)

Push – transmits a data link request for an alternate airport list uplink.

3 INDEX

Push – displays the INIT/REF INDEX page.

4 Alternate List Purge/Confirm (ALTN LIST PURGE/CONFIRM)

When no list exists, alternate airports can be selected from the navigation database.

Selecting the PURGE prompt arms the purge function and displays a CONFIRM prompt before the list is deleted.

Push – deletes all airports from the list.

A new list must be uplinked after a purge.

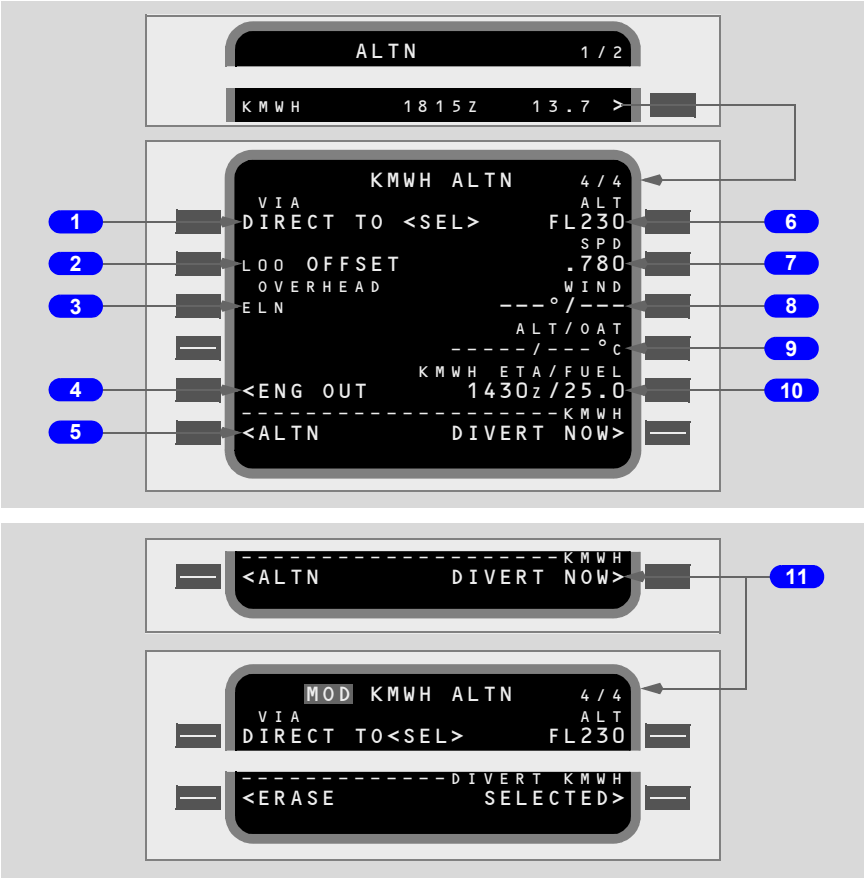
XXXX Alternate Page

Each of the four alternate airports displayed on the ALTN page 1/2 has a related XXXX ALTN page. The XXXX ALTN pages display specific data about alternate airports, the route used for a diversion, and the conditions on which the ETA and fuel calculations are based. All data on the page is related to the alternate airport displayed in the page title.

Three route options to the airport can be selected:

- DIRECT TO – direct to alternate
- OFFSET – flight plan route with an offset
- OVERHEAD – flight plan route to a waypoint, then direct to alternate

The selected route option has an effect on ETA and fuel remaining. It is identified by <SEL>. Selection of a route option for one alternate selects the same route option for the other three alternates.



1 VIA DIRECT TO

Push – selects DIRECT TO route option.

All flight plan waypoints are deleted.

2 VIA OFFSET

Push –

- with scratchpad empty, selects OFFSET route option
- with offset data in scratchpad, enters offset data. Does not select offset option.

Entry and exit to the offset is the same as for the RTE page offset. Flight plan waypoints are retained.

3 VIA OVERHEAD

Push –

- with scratchpad empty, selects OVERHEAD option
- with overhead data in scratchpad, enters overhead data. Does not select overhead route option

Displays active waypoint in flight plan.

The waypoints up to the selected or entered overhead waypoint are retained, then routing is direct to the alternate airport. All waypoints after overhead waypoint are deleted.

Enter any waypoint in the active or modified route.

4 Engine Out (ENG OUT)

This prompt performs the same function as described on the cruise page in the FMC Cruise section. It can be selected before or after the diversion is selected.

5 Alternate (ALTN)

Push – displays the ALTN 1/2 page.

6 Altitude (ALT)

Entry of any valid altitude or flight level into this line causes a recomputation of ETA and arrival fuel. Altitude entries do not become part of the diversion modification. Altitude entries apply to all four alternates.

Displays the altitude for which ETA and arrival fuel are calculated.

The scratchpad message UNABLE ALT displays if the entry is above maximum altitude or the top of climb point for divert is after top of descent point for divert.

7 Speed (SPD)

Entry of speed or Mach number into this line causes a recomputation of ETA and arrival fuel. Speed entries do not become part of the diversion modification. Speed entries apply to all four alternates.

Speed modes available are:

- ECON (economy)
- LRC (long range cruise)
- EO (engine out)
- EO LRC (engine out long range cruise)
- CO (company speed)
- any CAS or Mach

8 WIND

Entry of data causes recomputation of ETA and arrival fuel. A wind entry can be made for each of the four alternates. A wind entry applies to only one alternate.

Valid entry is a direction in degrees/speed in knots from 1 to 250.

9 Altitude/Outside Air Temperature (ALT/OAT)

Entry of data into these lines causes a recomputation of ETA and arrival fuel. A separate ALT/OAT entry may be made for each of the four alternates.

Displays the OAT for a specific altitude.

Valid entry is an altitude/temperature in degrees C.

10 Alternate Airport ETA/Fuel (XXXX ETA/FUEL)

Displays calculated airport ETA and arrival fuel based on the selected route, altitude, and speed displayed on this page.

11 XXXX DIVERT NOW

This prompt performs the same function as described on the ALTN 1/2 page.

Note: After a divert is executed, the XXXX ALTN page data is not updated until all CDUs change to a page other than the XXXX ALTN page.

Holding

The FMC computes holding patterns with constant radius turns based on current wind and FMC commanded airspeed. The pattern size is limited to FAA or ICAO protected airspace. In LNAV, the AFDS tracks the holding pattern using up to a 30 degree bank angle. Strong winds or airspeed in excess of FAA or ICAO entry speeds may result in the airplane flying outside the protected airspace.

With LNAV active before sequencing the holding fix, holding pattern entries are determined by the following:

- airplane track, not heading or direction from which the active route approaches the holding pattern, determines the entry method used (parallel, teardrop, or direct entry)
- the airplane flies the initial outbound leg a computed distance from the holding fix, rather than a specific time. The computed distance is a function of the command airspeed and computed wind at the time the holding pattern becomes active
- teardrop entries use a 40 degree offset angle

Holding Entry

[AIMS 03 FMC Software]

Airplane track to the holding fix determines the entry type; direct, teardrop, or parallel. To make efficient use of the holding airspace, lateral guidance may direct the initial turn to the holding pattern prior to crossing the holding fix (fly-by). The holding entry path displays on the ND. For all holding entry types, lateral guidance directs the airplane to fly-by or fly-over the holding fix and to remain on the holding side of the inbound holding course. Depending on the entry track for a direct entry, the flight path may extend slightly beyond the displayed outbound holding turn. For teardrop and parallel entries, the flight path remains within the confines of the depicted holding pattern displayed on the ND. Remaining within the prescribed holding airspace requires the airplane to be at holding airspeed at the holding fix.

Hold Page (First Hold)

The hold page is used to enter a holding pattern in the route.

When the flight plan does not contain a holding pattern, pushing the HOLD function key displays the RTE X LEGS page with the HOLD AT line.

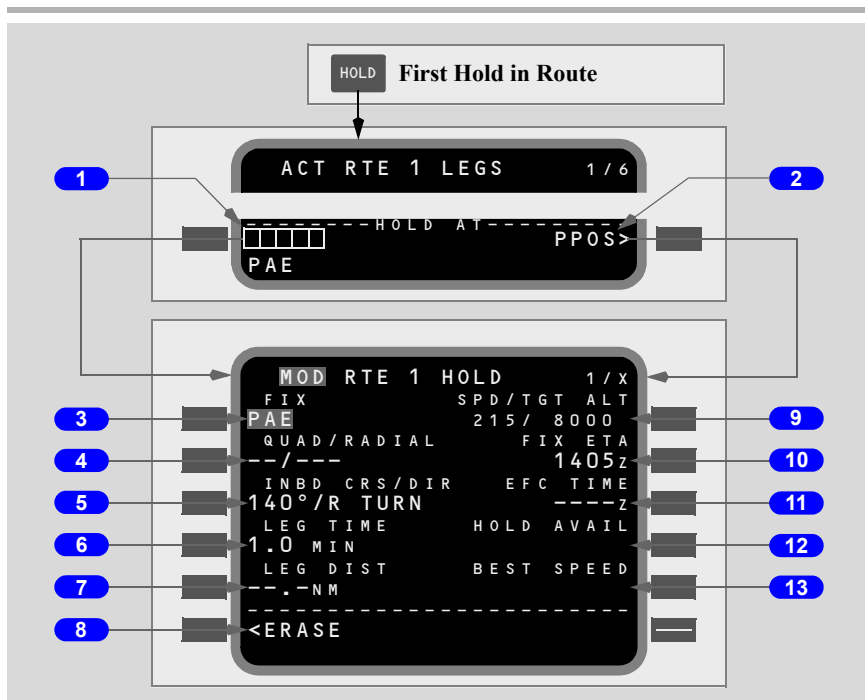
Two versions of the hold page are possible:

- an airway or procedure holding pattern
- a flight crew-entered holding pattern

The holding page displays actual or default data about the holding pattern.

Entries modify the route. Modifications can be erased or executed.

Active holding patterns are magenta on the ND.



1 HOLD AT

Displays boxes to enter the holding fix: a RTE LEGS, database, or pilot-defined waypoint; a navaid or airport identifier; or a FAF already in the flight plan.

Entering a holding fix displays the RTE X HOLD page.

2 HOLD AT Present Position (PPOS)

Push -

- creates a holding pattern at present position
- execution establishes the holding fix at the position when EXEC is pushed and displays RTE HOLD

3 Holding FIX

Displays the holding fix.

4 Quadrant/Radial (QUAD/RADIAL)

Normally displays dashes.

Valid entry is X/XXX, XX/XXX, or /XXX. Example: NW/330.

Entry changes INBD CRS/DIR to agree.

5 Inbound Course/Direction (INBD CRS/DIR)

Displays inbound course and turn direction.

Valid entry is XXX (inbound course), XXX/X (inbound course/turn direction), /X or X (turn direction).

Entry changes QUAD/RADIAL to agree.

Displays magenta when the holding fix is the active waypoint.

6 Leg Time (LEG TIME)

Displays 1.0 MIN (minute) at or below 14,000 feet.

Displays 1.5 MIN above 14,000 feet.

Displays dashes when an entry made on LEG DIST line.

Valid entry is X, X.X, or .X.

When climbing/descending through 14,000 feet with VNAV active and the SPD/TGT ALT at 1R displays in large font, the FMC adjusts the leg time (1.0 MIN at or below 14,000 feet; 1.5 MIN above 14,000 feet).

7 Leg Distance (LEG DIST)

Normally displays dashes. Allows entry of leg distance for hold.

Entry displays dashed on LEG TIME line.

Valid entry is XX.X or X.X.

8 ERASE

Erases all FMC modifications.

9 Speed/Target Altitude (SPD/TGT ALT)

Dashes display or fix speed/altitude constraint from the RTE LEGS page.

Manual entries are in large font.

During cruise, entry of a target altitude lower than CRZ ALT modifies the DESCENT page and displays a T/D. After T/D, the DESCENT page remains active unless a new cruise altitude is entered.

Speed or altitude may be entered.

10 FIX ETA

With no EFC TIME entry, displays time the airplane will next pass the holding fix.

With EFC TIME entry, displays time the airplane will pass the holding fix after the EFC time. The FMC uses this time to calculate downtrack ETAs and fuel values based on departing the holding fix at the new FIX ETA.

11 Expect Further Clearance Time (EFC TIME)

Normally displays dashes.

Valid entry is XXXX (time).

Entry changes performance predictions for the route after holding.

12 Hold Available (HOLD AVAIL)

Displays holding time available before requiring reserve fuel to reach the destination.

13 BEST SPEED

Displays the best holding speed for the airplane gross weight, altitude, and flap setting.

Note: May exceed ICAO limit speed.

HOLD Page (Existing Hold)

When one or more holding patterns exist in the route, push the HOLD key to display the hold page for the first holding pattern. When the hold is the next LNAV event, active commands display in magenta. Holding parameters can be monitored and changed on this page. New holding patterns are added using the NEXT HOLD prompt.

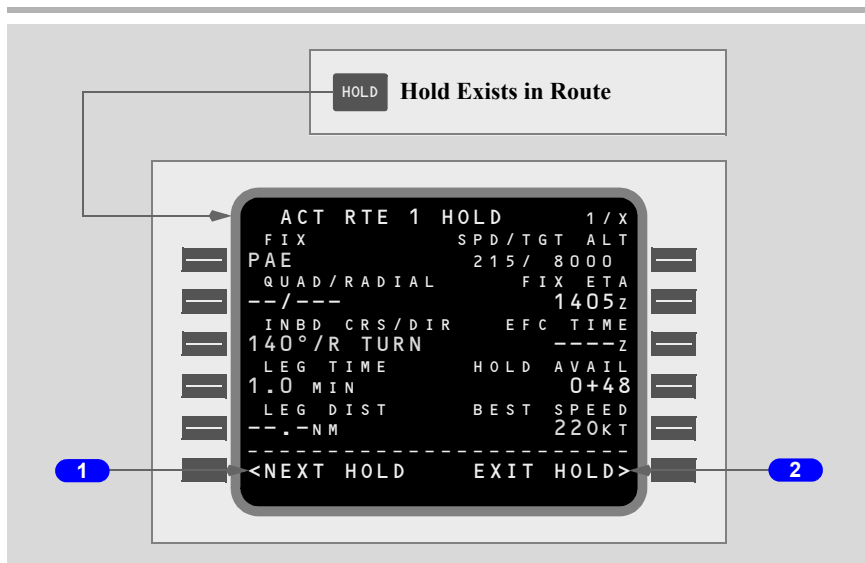
Most holding patterns are part of a procedure or airway and remain active until the flight crew executes an exit from holding. This may be accomplished in one of two ways.

- on the ACT RTE LEGS page, deleting or bypassing the HOLD AT waypoint causes LNAV to command a direct to the next waypoint
- on the ACT RTE HOLD page, selecting and executing EXIT HOLD> causes LNAV to command the airplane to continue in the holding pattern until arriving at the holding fix, at which time the airplane exits the holding pattern

Following execution of the exit hold, only the remaining portion of the holding pattern back to the holding fix displays. Exit from the holding pattern may occur prior to crossing the holding fix (“fly-by”) if the course to the next waypoint is not closely aligned with the holding inbound course. The exiting flight path will remain within the confines of the protected holding airspace. The exit flight path displays on the ND. At high groundspeed and extreme exit track angles (angle between the course to the next route waypoint and the inbound course to the holding fix), a path discontinuity, typically in the shape of a “Z”, may display on the ND as the exit flight path. In all instances, LNAV provides appropriate lateral guidance to intercept the active leg to the next route waypoint.

The FMC automatically commands an exit from some holding patterns in procedures under the following conditions.

- for instrument approach holding patterns designed as a course reversal in lieu of a procedure turn, the airplane exits holding upon arrival at the holding fix inbound. Header at 1L displays PROC HOLD
- for some holding patterns in SIDs, the airplane exits holding when arriving at an altitude. Header at 1L displays HOLD AT



1 NEXT HOLD

Push – displays a new hold page for a new holding pattern entry.

2 EXIT HOLD

Push –

- arms a holding pattern exit
- EXIT ARMED displays in shaded white; when executed, airplane returns to the holding fix via the inbound course for holding pattern exit

Intentionally
Blank

Flight Management, Navigation**Chapter 11****FMS Alternate Navigation System Description****Section 50**

Introduction

The CDUs can be used as an alternate navigation system if both FMCs fail. The CDUs calculate lateral navigation for the autopilot flight director system (AFDS). Pushing the LNAV switch engages the lateral steering commands. A master CDU is selected and uses ADIRU position data for navigation. VNAV is not available. Autothrottles may be available. The CDU can be used to tune the navigation radios.

During normal FMC operation, all system capabilities are contained within the FMCs. During alternate navigation operation, the CDUs use their own internal memory and computing capability. Active flight plan data from one CDU is copied to the other CDUs. Modifications display on the CDU used for the modifications. The other CDU displays the changes after execution.

All three CDUs receive inputs from the ADIRU. Usually, the left CDU provides information to the left ND map and the right CDU provides information to the right ND map. The center CDU is automatically selected after failure of the left or right CDU.

The autopilot selects a master CDU for lateral steering commands in this order:

- left CDU if functioning, then
- center CDU if functioning, then
- right CDU.

Alternate Navigation Waypoints

The CDUs do not have a performance or navigation database. The CDUs continuously copy the active route from the FMC. If both FMCs fail, the CDUs retain flight plan waypoints except for conditional waypoints, offsets, and holding patterns. Waypoints on the copied route can be referenced by either their identifier, or latitude and longitude.

New waypoints can only be entered in latitude and longitude. This includes waypoints the flight crew has deleted from the copied route.

Alternate Lateral Navigation

All CDU calculations are based on a great-circle course between waypoints. The CDU does not accept undefined waypoints or conditional waypoints. Complete departure or arrival/approach procedures cannot be manually entered or cross-loaded from the FMC if they contain undefined or conditional waypoints. The CDU makes a discontinuity at those waypoints. However, individual legs of a procedure can be manually entered or cross-loaded if they constitute a great-circle course.

Route Changes

Route changes are made on the ALTERNATE NAVIGATION LEGS page in almost the same manner as normal FMC operations. All courses between waypoints are direct routes. When the active waypoint is modified, the only navigational choice is present position direct to the modified active waypoint.

A route change to any one CDU displays on the other CDUs when the modification is executed.

Course Reference

The ADIRU supplies magnetic variation for present position. Only the active waypoint course can be referenced to magnetic north. All subsequent waypoint courses are true courses.

Alternate Navigation Radio Tuning

The radios must be manually tuned on left and right CDUs in alternate navigation. The left CDU tunes the left VOR, DME, ADF, and left and center ILS. The right CDU tunes the right VOR, DME, ADF, and right ILS. Manual tuning is accomplished on the ALTERNATE NAVIGATION RADIO page.

The radios must be manually tuned on left and right CDUs in alternate navigation. The left CDU tunes the left VOR, DME, and left and center ILS. The right CDU tunes the right VOR, DME, and right ILS. Manual tuning is accomplished on the ALTERNATE NAVIGATION RADIO page.

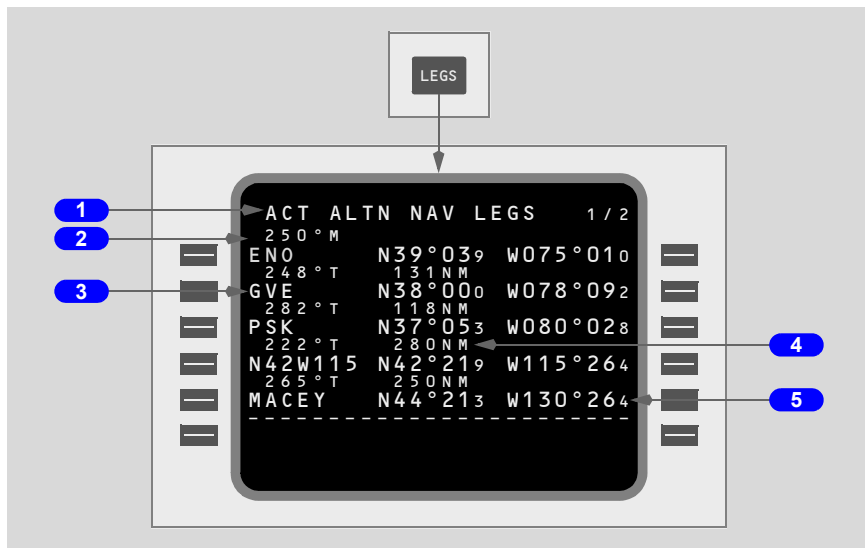
Alternate Navigation CDU Pages

The alternate navigation system operates from three CDU pages:

- ALTERNATE NAVIGATION LEGS
- ALTERNATE NAVIGATION PROGRESS
- ALTERNATE NAVIGATION RADIO.

Alternate Navigation Legs Page

This page displays data about each leg of the route. The route can be modified. Waypoint speed and altitude restrictions are not displayed because performance data is not available.



1 Page Title

If the ACT ALTN NAV LEGS page is modified, MOD ALTN NAV LEGS displays until the EXEC key is pushed.

2 Leg Direction

Displays course to the waypoint.

Course reference is M for magnetic, T for true.

Active waypoint leg direction can be magnetic or true. Subsequent waypoint leg directions are true.

3 Waypoint Identifier

Displays the waypoint by name or latitude/longitude.

Valid entries are waypoint names in the route or latitude/longitude for new waypoints.

4 Distance to Waypoint

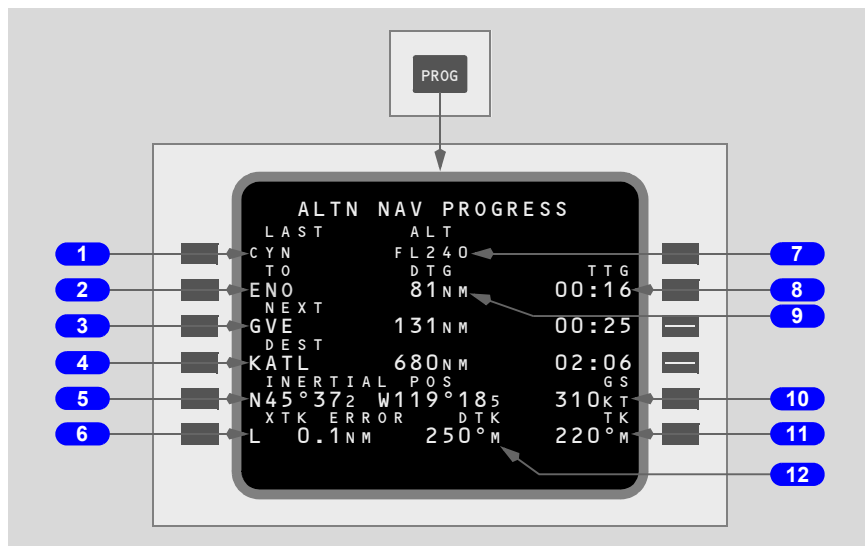
Displays the great circle distance between waypoints.

5 Waypoint Coordinates

Displays the waypoint coordinates.

Alternate Navigation Progress Page

This page displays general data about flight progress.



1 LAST

Displays the identifier of the last waypoint.

2 TO

Displays the active waypoint on the route. The waypoint identifier displays in magenta. This distance and time to go display to the right of the waypoint.

3 NEXT

Displays the waypoint after the TO waypoint. NEXT data displays in white.

4 Destination (DEST)

Displays the identifier for the route destination waypoint or airport. Any waypoint on or off the route can be entered. Time and distance data temporarily displays for that waypoint.

Display options:

- destination airport identifier; distance and time to go along track to the destination airport.
- entry of an existing flight plan waypoint (identifier or latitude/longitude) causes the line title to change to ENROUTE WPT. Time and distance to go are from present position along the flight plan route to the entered waypoint
- entry of a waypoint not in the flight plan causes the line title to change to DIR TO ALTERNATE. Time and distance to go are from the present position direct to the new waypoint.

5 Inertial Position (INERTIAL POS)

Displays ADIRU present position.

6 Cross Track Error (XTK ERROR)

Displays airplane left or right cross-track error in nautical miles from the active route track.

7 Altitude (ALT)

Displays airplane altitude when the LAST waypoint was crossed.

8 Time to Go (TTG)

Displays time to go to associated waypoint or destination.

9 Distance to Go (DTG)

Displays distance to go to associated waypoint or destination.

10 Ground Speed (GS)

Displays ADIRU groundspeed.

11 Track (TK)

Displays airplane track angle relative to the true or magnetic reference selected on the HEADING REFERENCE switch.

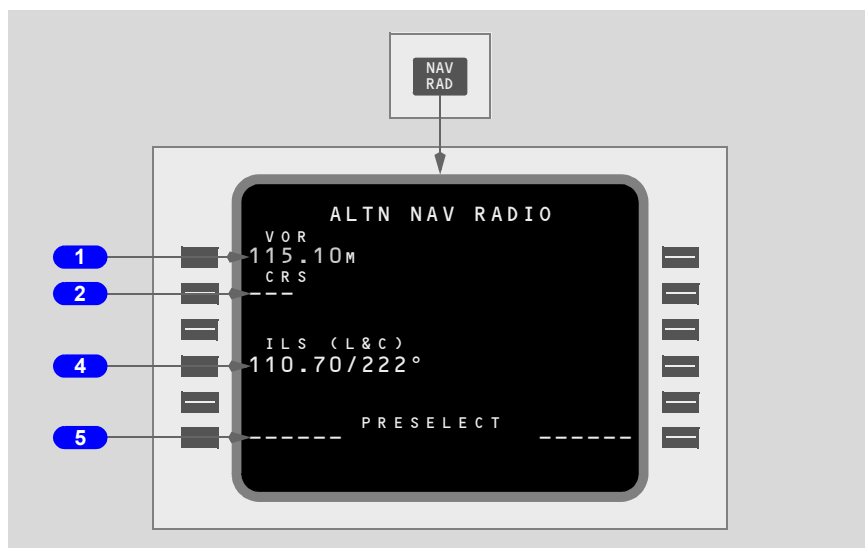
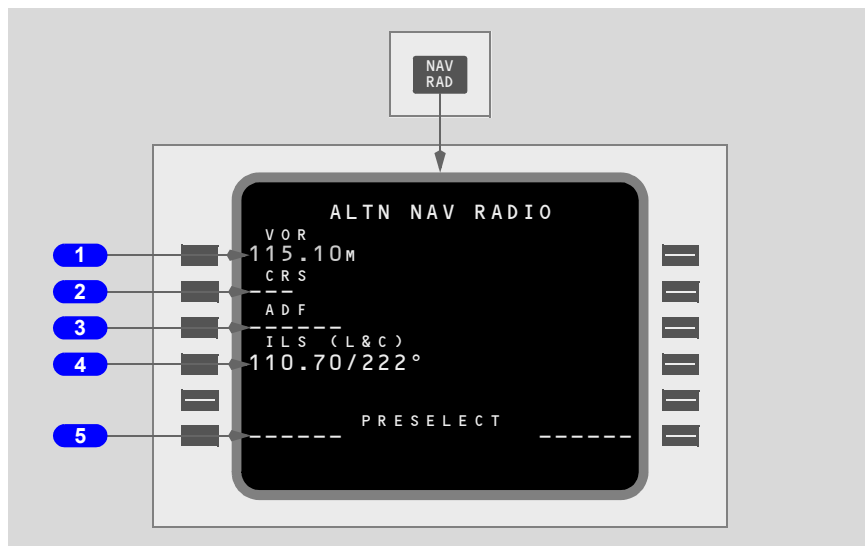
12 Desired Track (DTK)

Displays desired track angle relative to the true or magnetic reference selected on the HEADING REFERENCE switch.

Alternate Navigation Radio Page

Navigation radios are tuned on this page and related parameters display. If both FMCs fail, access is by the NAV RAD key on the left and right CDUs only. Autotune is not available. The CDUs operate independently for navigation radio tuning:

- the left CDU tunes the left radios and center ILS
- the right CDU tunes the right radios.



1 VOR

Displays last selected VOR frequency. Tuning status displays as manual (M).

Valid entry is VOR frequency or VOR frequency/course.

Entry tunes related DME frequency.

2 Course (CRS)

Displays selected VOR course.

Valid entry is VOR course or VOR frequency/course.

3 ADF

Displays ADF frequency. Tuning status displays as ANT or BFO.

Displays dashes if no ADF frequency entered on NAV RAD or ALTN NAV RAD pages after initial power up.

Valid entry is ADF frequency or ADF frequency suffixed with A or B. Suffix may be changed after entry.

3 ADF

[ADF not installed on Freighter; or with AIMS V14 delete option selected]

ADF tuning is inhibited.

4 ILS

Displays last selected ILS frequency, ILS frequency and course, or PARK.

Valid entries are:

- ILS frequency
- ILS frequency/front course
- front course only (a frequency must already be displayed).

Note: If the ILS was in autotune at the time of the FMC failure, the frequency and course are automatically copied to the ALTN NAV RADIO page.

Note: The ILS frequency displays PARK when no frequency is tuned. Deleting the ILS frequency parks a tuned ILS.

Note: ILS course and frequency must be entered on the left, center, and right ALTN NAV RADIO page.

The line title is L & C on the left CDU and R on the right CDU.

DME data for the ILS displays when the EFIS control panel ND mode selector is set to APP.

5 PRESELECT

Allows entry of two separate preselected frequencies and/or frequencies/courses. Valid entries are any of the entries that can be made on the other lines.

**Flight Management, Navigation
EICAS Messages****Chapter 11
Section 60****Navigation EICAS Messages**

The following EICAS messages can display.

Message	Level	Aural	Message Logic
ADIRU ALIGN MODE	Memo		ADIRU is in align mode.
FMC	Advisory		Both FMCs have failed or FMC selector is in L with left FMC failed or in R with right FMC failed.

[FMC L/R OPTION]

FMC L, R	Advisory		Affected FMC has failed.
----------	----------	--	--------------------------

FMC MESSAGE	Advisory		A message is in the FMC scratchpad.
-------------	----------	--	-------------------------------------

[AIMS 2003 and OPTION SELECTED]

FMC RUNWAY DISAGREE	Caution	Beeper	Airplane is not on FMC origin runway when either engine's thrust is in the takeoff range.
---------------------	---------	--------	---

GPS	Advisory		GPS has failed.
ILS ANTENNA	Caution	Beeper	Two or more ILS receivers are not using the correct antennas for best reception.
NAV ADIRU INERTIAL	Caution	Beeper	ADIRU is not capable of providing valid attitude, position, heading, track, and groundspeed
NAV AIR DATA SYS	Advisory		Information from the air data sources is no longer being combined for display.
NAV UNABLE RNP	Caution	Beeper	Navigation performance does not meet required accuracy during all phases of flight.
SINGLE SOURCE ILS	Caution	Beeper	Both PFDs and NDs are using the same source for ILS information.
TRANSPONDER L, R	Advisory		Affected transponder has failed.

FMC Messages

FMC messages indicate: degraded system operation, data input errors, or data link status. The messages are categorized as:

- alerting messages
- advisory messages
- communications messages
- entry-error advisory messages.

The scratchpad messages display according to their level of importance. A less important message replaces another message in the scratchpad when the CLEAR key is pushed or the condition is corrected.

The EICAS displays the advisory message FMC MESSAGE when there is an FMC alerting message. The EICAS displays the message •FMC when there is an FMC communications message. All FMC messages illuminate the CDU message (MSG) light. Clear the message or correct the condition to cancel the message.

FMC Alerting Messages

FMC alerting messages:

- display in the CDU scratchpad
- cause the EICAS advisory message FMC MESSAGE to display
- illuminate the CDU message light (MSG).

Use the CLEAR key or correct the condition responsible for the message to remove the message. The message is temporarily removed from the scratchpad when manually entering data. The message returns when the data is removed from the scratchpad.

ALIGNMENT REINITIATED – ADIRU alignment has automatically restarted due to airplane motion, or if the flight crew-entered initial position fails the alignment comparison tests.

CHECK ALT TGT – VNAV activates when the airplane is between the MCP and FMC altitudes. VNAV maintains level flight.

CHECK AIRLINE POLICY – after loading a new airline modifiable information file, the FMC determines a parameter is invalid. The FMC uses the loaded value and notifies the flight crew of the difference. This is a maintenance function.

Note: If the scratchpad message is cleared, it does not display again for that load.

DESCENT PATH DELETED – VNAV active and all waypoint altitude constraints defining the descent profile deleted.

Note: This message displays before execution of the modification which deletes the descent path.

DISCONTINUITY – LNAV active and the route is not defined after the waypoint (except when the waypoint is before a manually terminated leg, such as FM, VM, HM legs).

- FM – a course from a fix to a flight crew entered manual route termination
- VM – a heading leg from a fix to a flight crew entered manual route termination
- HM – a holding pattern to a flight crew entered manual route termination.

DRAG REQUIRED – VNAV active and additional drag required or autothrottle off and less thrust required to maintain the VNAV descent path.

END OF OFFSET – LNAV active and two minutes prior to end of active route offset. AFDS maintains last heading if active route offset overflowed.

END OF ROUTE – LNAV active and end of active route overflowed. AFDS maintains last heading.

ENTER INERTIAL POSITION – the flight crew–entered present position did not pass one of the ADIRU comparison checks, or the ADIRU is ready to change to navigate mode and has not received a present position entry. Use the CLEAR key to remove this message.

ILS TUNE INHIBIT - MCP - flight control computers inhibiting changes in ILS tuning and either a manual operation in the ILS tuning field attempted or a new arrival ILS approach activated.

INERTIAL/ORIGIN DISAGREE – the airplane is on the ground and one of these conditions exist:

- The inertial position entered on the POS INIT page differs from the position of the origin airport in the active route by more than 6 NM.
- A route is activated and executed containing an origin airport with a position that differs from the ADIRU inertial position by more than 6 NM.

INSUFFICIENT FUEL – estimated fuel at destination less than entered RESERVES value. This may indicate an engine fuel leak.

LIMIT ALT FLXXX – the flight crew– or FMC–selected altitude is greater than the VNAV limit altitude.

LNAV BANK ANGLE LIMITED - before entering or while flying a curved path or holding pattern, the FMC predicts the LNAV roll command will be limited by thrust or buffet based roll limits.

NAV DATA OUT OF DATE – the clock/calendar date is after the active navigation database valid calendar cycle.

NAV INVALID–TUNE XXXX – RNAV or VOR approach procedures must have a specific navaid tuned. It is either not tuned or a valid signal is not being received.

NO ACTIVE ROUTE – LNAV selected and no active route activated.

NO ROUTE DATA – in ALTN NAV, LNAV selected and the CDU does not have an active lateral route.

PERF/VNAV UNAVAILABLE – VNAV selected and gross weight, cost index, or cruise altitude are not entered.

RESET MCP ALT – 2 minutes prior to the top of descent point with VNAV active and MCP not set to altitude below cruise altitude.

RTA FIX DELETED – RTA fix has been deleted from the modified flight plan.

RW/ILS CRS ERROR –

- the airplane is within ILS automatic tuning range and the tuned ILS course does not match the course for the active arrival runway, or
- the FMC is not receiving valid course data from the same ILS the FMC is using for frequency data
- inhibited if scratchpad message ILS TUNE INHIBITED–MCP displayed.

RW/ILS FREQ ERROR –

- the airplane is within ILS automatic tuning range and the tuned ILS frequency does not match the frequency for the active arrival runway, or
- the FMC is not receiving valid frequency data from either ILS
- inhibited if scratchpad message ILS TUNE INHIBITED – MCP displayed.

SINGLE FMC L OPERATION – the right FMC is not operational.

SINGLE FMC R OPERATION – the left FMC is not operational.

TAKEOFF SPEEDS DELETED – selected V speeds are invalid.

THRUST REQUIRED – VNAV active, autothrottle disconnected, and additional thrust required to track VNAV descent path and maintain speed.

UNABLE FLXXX AT RTA FIX – predicted crossing altitude at RTA fix less than FLXXX, but predicted ETA within tolerance.

UNABLE HOLD AIRSPACE - the radius of the holding pattern calculated by the FMC exceeds the FMC maximum protected airspace limits.

UNABLE RTA – RTA not achievable within applicable arrival time tolerance.

UNABLE NEXT ALT – VNAV active and climb not sufficient to comply with waypoint altitude constraint.

VERIFY POSITION – the FMC calculation of airplane present position is based on conflicting data. The possible conflicts are:

- the active FMC and the inactive FMC positions differ by more than twice the RNP for 5 seconds
- the difference between the FMC position and the navigation aid being used (GPS, DME, VOR, or inertial) is greater than 12NM for 5 seconds.

VERIFY RNP – POS REF 2/3 – the default RNP has changed due to a change in flight phase and the flight crew entered RNP value exceeds the new default RNP value.

VIA OFFSET INVALID – flight conditions invalidate the modification with a divert to an alternate airport via OFFSET.

FMC Communications Messages

FMC communications messages:

- display in the CDU scratchpad
- cause the EICAS communications message •FMC to display
- illuminate the CDU message light (MSG)
- cause the communications aural high–low chime to sound.

ALTN UPLINK – Up to four company–preferred alternate airports and associated data has been received and is available for preview on the ALTN page.

ALTN INHIBIT UPLINK – uplink contains two airports for the ALTN page 1/2 ALTN INHIB line.

ALTN LIST UPLINK – a company list of up to 20 alternate airports has been received and is available on the ALTN LIST page.

DES FORECST UPLINK READY – descent forecast data has been received and is available for loading on the DESCENT FORECAST page.

FLT NUMBER UPLINK – a new flight number has been received and is available on the RTE page 1/X.

INVALID TAKEOFF XXX/YYY – takeoff data for up to six runways or runway intersection pairs has been received but some data for one runway or runway intersection pair (RWXXX/YYY) is invalid.

PARTIAL ROUTE X UPLINK – a new route has been uplinked to the FMC but a portion of the route could not be loaded.

PERF INIT UPLINK – performance initialization data has been received and is available for preview on the PERF INIT page.

ROUTE X UPLINK READY – a new route or route modification has been received and is available for loading on the RTE X page.

TAKEOFF DATA LOADED – An uplink containing takeoff data matching the runway/position entry on the takeoff page is available for preview (only displays after an initial takeoff uplink has been received) or alternate thrust and/or flaps have been selected.

TAKEOFF DATA UPLINK – an uplink containing takeoff data matching the runway on the takeoff page is available for preview.

WIND DATA UPLINK READY – wind data has been received and is available for loading into the active route.

FMC Advisory Messages

FMC advisory messages display:

- on the CDU scratchpad
- and illuminate the CDU message light (MSG).

DELETE – DELETE key pushed.

HOLD AT XXXX – a waypoint not contained in the active route is entered into the HOLD AT box on the RTE LEGS page, after selection of the HOLD function key. Selection of HOLD AT XXXX into a RTE LEGS page waypoint line makes a holding fix at the XXXX waypoint.

INVALID ALTN UPLINK – a company-preferred list of alternate airports and associated alternate data has been received; the data is not valid and cannot be displayed.

INVALID ALTN LIST UPLINK – a company list of up to 20 alternate airports has been received; the data is not valid and cannot be displayed.

INVALID FLT NO UPLINK – a new flight number has been received; the data is not valid and cannot be displayed.

INVALID FORECAST UPLINK – descent forecast data has been received; the data is not valid and cannot be displayed.

INVALID PERF INIT UPLINK – performance initialization data has been received; the data is not valid and cannot be displayed.

INVALID ROUTE UPLINK – a new flight plan route or modification to the active flight plan route has been received; the data is not valid and cannot be displayed.

INVALID TAKEOFF UPLINK – takeoff data for up to six runways or runway-intersection pairs has been received; the data is not valid and cannot be displayed.

INVALID WIND DATA UPLINK – enroute wind data has been received; the data is not valid and cannot be displayed.

MAX ALT FLXXX – the altitude entry on any CDU page is above the performance calculated maximum altitude.

NOT ON INTERCEPT HEADING – LNAV selected and the airplane is outside active capture criteria and the present heading will not intercept the active leg.

ROUTE X UPLINK LOADING – a new flight plan route or modification to the active flight plan route has been received and is being loaded after flight crew selection of the LOAD prompt.

STANDBY ONE – the FMC requires more than 4 seconds to display data.

TIMEOUT–RESELECT – communication between the FMC and the CDU has failed. The flight crew must reselect FMC on the CDU MENU page.

UNABLE CRZ ALT – performance predicts a zero cruise time at the entered cruise altitude.

FMC Entry Error Messages

FMC entry–error messages:

- display in the CDU scratchpad
- illuminate the CDU message light (MSG)
- push the CLEAR key to remove the message before any data can be entered into the scratchpad.

ARR N/A FOR RUNWAY – the runway/approach selected is not compatible with arrival selected.

CRS REVERSAL AT FA FIX – a conflict exists between the default final approach (FA) waypoint (result of a runway or VFR approach selection) and the flight plan before it.

ENG OUT SID MOD – an engine failure is sensed after takeoff before the flaps are fully retracted; the FMC has automatically loaded an available engine out standard instrument departure as a route modification to the active route.

ILS TUNE INHIBITED – MCP – ILS tuning is inhibited with the:

- autopilot engaged, and localizer or glideslope captured
- only the flight director is engaged and either the localizer or the glideslope is captured, and the airplane is below 500 feet radio altitude.

Any attempt to manually change the ILS frequency or select another ILS approach on the CDU displays this message. To make the necessary changes:

- above 1500 feet radio altitude – deselect approach on the MCP
- below 1500 feet radio altitude – select TO/GA

or,

- disengage the autopilot
- turn both flight directors OFF, and
- turn at least one flight director ON.

INVALID DELETE – deletion of selected data is not allowed.

INVALID ENTRY – entry format or range is incorrect for the selected field or the entered airway or TO waypoint does not coincide with the navigation database.

NOT IN DATABASE – data is not in the route or the navigation database.

ROUTE FULL – the route is filled to the allowable capacity.

RUNWAY N/A FOR SID – selected runway not compatible with SID.

TAKEOFF FLAPS DELETED – the FMC has deleted the takeoff flap setting on the TAKEOFF REF page. This occurs when the THRUST REDUCTION value is changed to the same value as the takeoff flap setting.

STANDBY ONE – the FMC temporarily prevents further CDU inputs.

UNABLE TO SEND MSG – the selected data link message cannot be transmitted.

V-SPEEDS UNAVAILABLE – for certain high thrust/low gross weight takeoff conditions, FMC V-speeds are not calculated. Adjust gross weight and/or takeoff thrust limit to enable V-speed calculations.

VERIFY RNP ENTRY – the entered RNP value is greater than the default RNP value for the present flight phase or, less than the present Actual Navigation Performance.

CDU Annunciator Lights

These annunciator lights illuminate when certain conditions exist.

DSPY – a flight plan modification is pending and the RTE, RTE LEGS, RTE DATA, or RTE HOLD page not containing the active leg or route segment is displayed, or a VNAV page (CLB, CRZ, or DES) not corresponding to the active VNAV mode is displayed.

OFST – an offset path has been entered and executed.

MSG – an FMC message is waiting to display or is displayed.

Fuel**Chapter 12****Table of Contents****Section 0**

Controls and Indicators	12.10
Fuel System	12.10.1
Fuel Jettison System	12.10.3
Fuel Indications	12.10.4
Normal Fuel Indications	12.10.4
Expanded Fuel Indications	12.10.5
Fuel Jettison Indications	12.10.9
Fuel Synoptic Display	12.10.11
Fuel Synoptic Indications	12.10.17
System Description	12.20
Introduction	12.20.1
Fuel Quantity	12.20.1
Fuel Temperature	12.20.1
Nitrogen Generation System (NGS)	12.20.2
Fuel Pumps	12.20.2
Fuel Pump Operations	12.20.3
Suction Feed	12.20.5
Fuel Crossfeed	12.20.5
Fuel Imbalance	12.20.5
Fuel Tank Locations and Capacities	12.20.6
Fuel Tank Locations	12.20.6
Fuel Tank Capacities	12.20.8
Fuel System Schematic	12.20.12
APU Fuel Feed	12.20.17
Fuel Jettison	12.20.17
Fuel Jettison Schematic	12.20.19
EICAS Messages	12.30
Fuel System FMS CDU Messages	12.30.1
Fuel System EICAS Messages	12.30.1

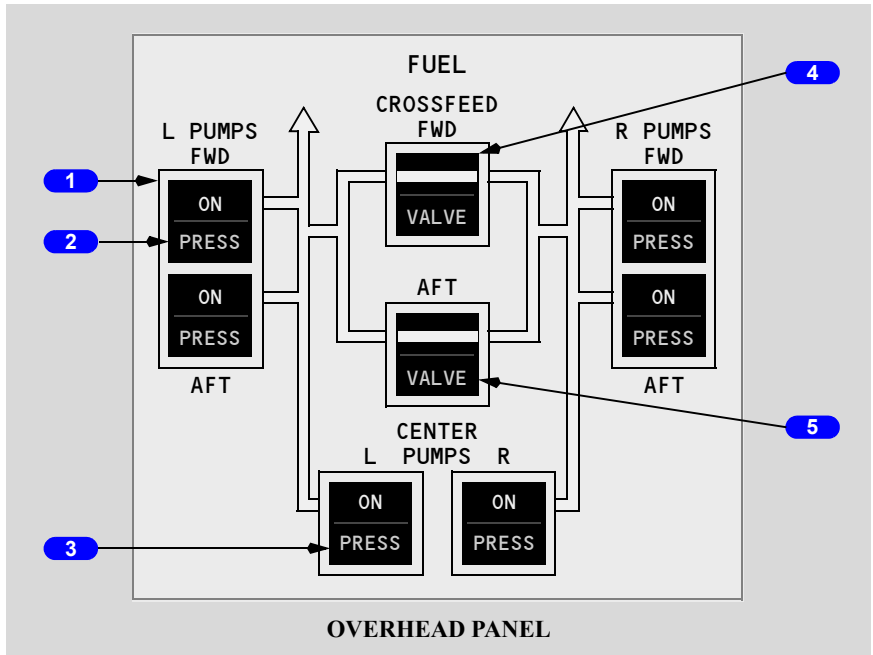
Intentionally
Blank

Fuel
Controls and Indicators

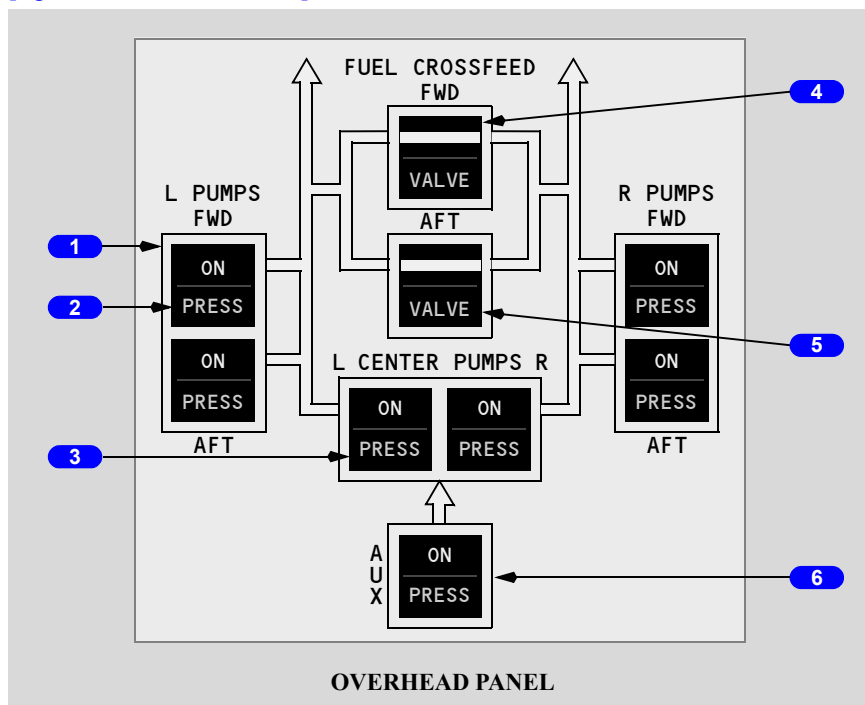
Chapter 12
Section 10

Fuel System

[Aux tank not installed]



[Option - aux tank installed]



1 Fuel Pump Switches

ON – the fuel pump is selected ON.

Off (ON not visible) – the fuel pump is selected off.

2 Forward and Aft Fuel Pump Pressure (PRESS) Lights

Illuminated (amber) – fuel pump output pressure is low.

3 Center Fuel Pump Pressure (PRESS) Lights

Illuminated (amber) –

- fuel pump output pressure is low with the pump selected ON
- illumination is inhibited when the center tank fuel pump switch is selected off.

4 CROSSFEED Switches

On (bar visible) – the crossfeed valve is selected open.

Off (bar not visible) – the crossfeed valve is selected closed.

5 Crossfeed VALVE Lights

Illuminated (amber) – the crossfeed valve is not in the selected position.

6 Auxiliary (AUX) Tank Switch

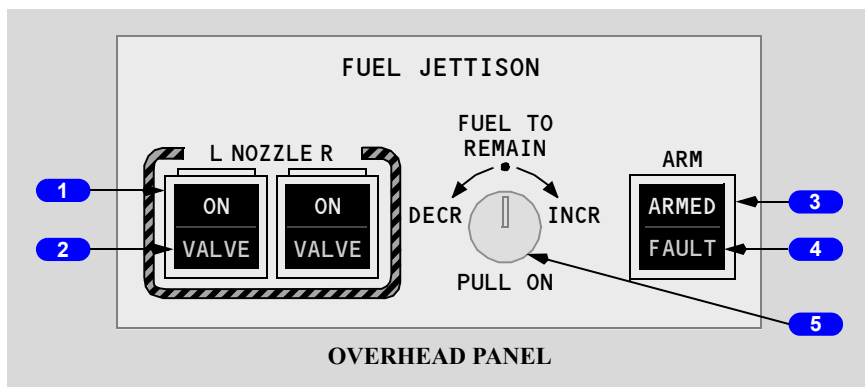
[Option - aux tank installed]

ON – fuel transfer is selected ON.

Off (ON not visible) – fuel transfer is selected off.

PRESS light illuminated (amber) –

- fuel pressure is low with transfer selected ON
- illumination is inhibited when the auxiliary tank switch is selected off.

Fuel Jettison System**1 Fuel Jettison NOZZLE Switches**

ON –

- the jettison nozzle valve is selected open in flight
- if in flight and jettison is armed, turns on both main tank jettison pumps and opens both center tank jettison isolation valves.

Off (ON not visible) – the jettison nozzle valve is selected closed.

2 Fuel Jettison Nozzle VALVE Lights

Illuminated (amber) – the jettison nozzle valve is not in the selected position.

3 Fuel Jettison ARM Switch

ARMED –

- arms the jettison system
- initializes fuel-to-remain at the MLW (maximum landing weight) fuel quantity.

Off (ARMED not visible) – disarms the jettison system.

4 Fuel Jettison FAULT Light

Illuminated (amber) –

- a system fault has occurred
- fuel jettison is inoperative.

5 FUEL TO REMAIN Selector

PULL ON – changes the mode from MLW to MAN.

Rotate –

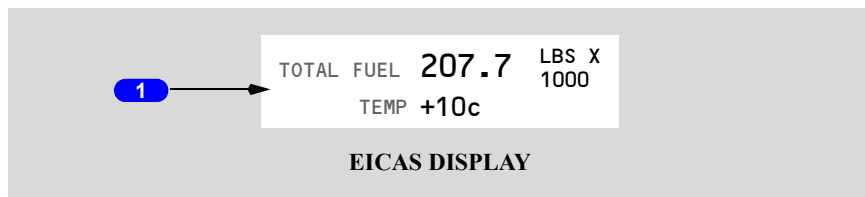
- rotate clockwise to increase, counterclockwise to decrease the MAN fuel-to-remain quantity
- sets the MAN fuel-to-remain quantity selection at the slow rate (first detent) or fast rate (second detent).

Push – automatically selects the MLW fuel-to-remain quantity.

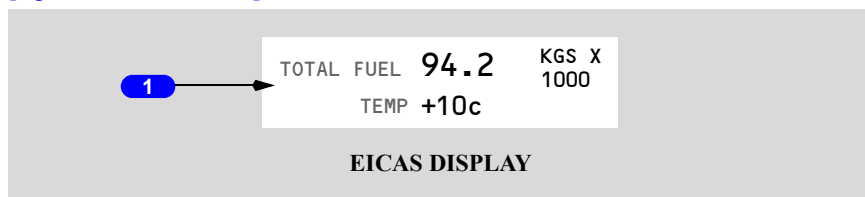
Fuel Indications

Normal Fuel Indications

[Option – English Units]



[Option – Metric Units]



1 Normal Fuel Indications

[Option – English Units]

Total fuel quantity (pounds x 1000).

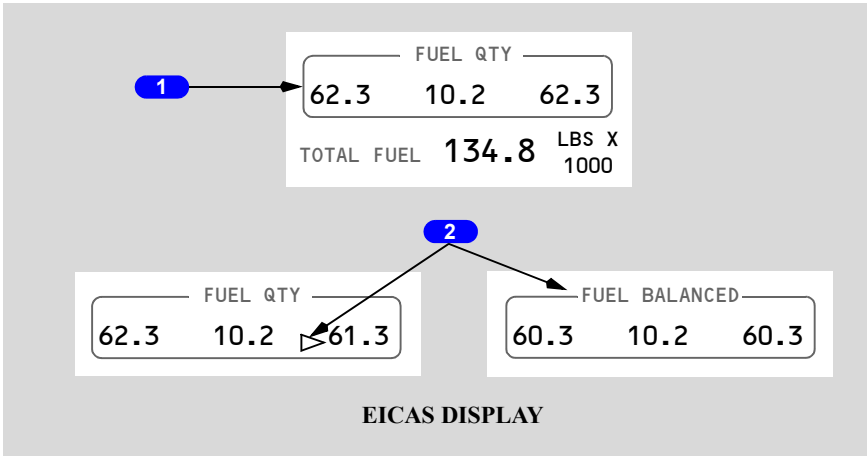
[Option – Metric Units]

Total fuel quantity (kilograms x 1000).

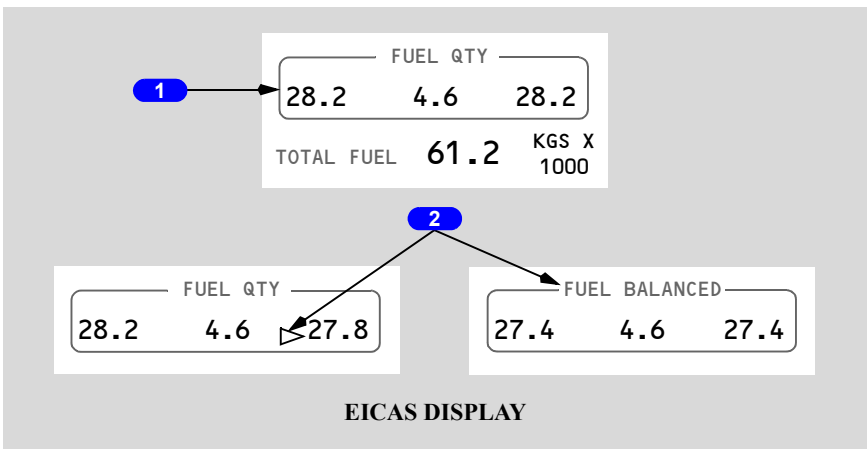
Fuel temperature (degrees Celsius).

Expanded Fuel Indications

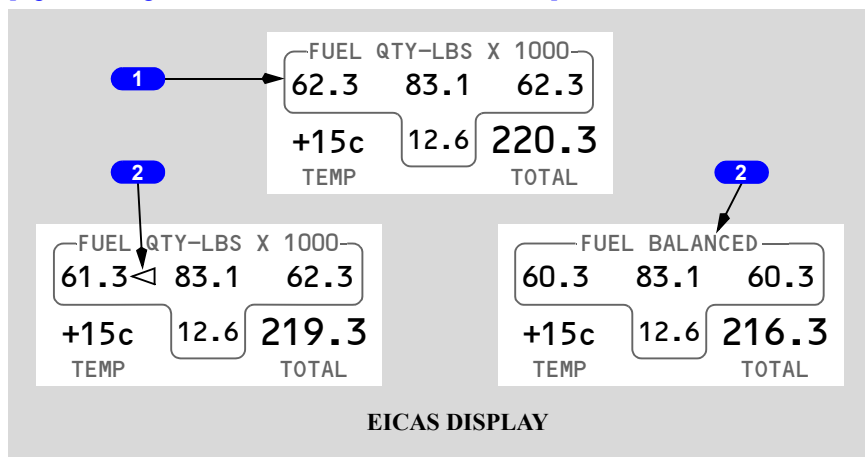
[Option - English Units, aux tank not installed]



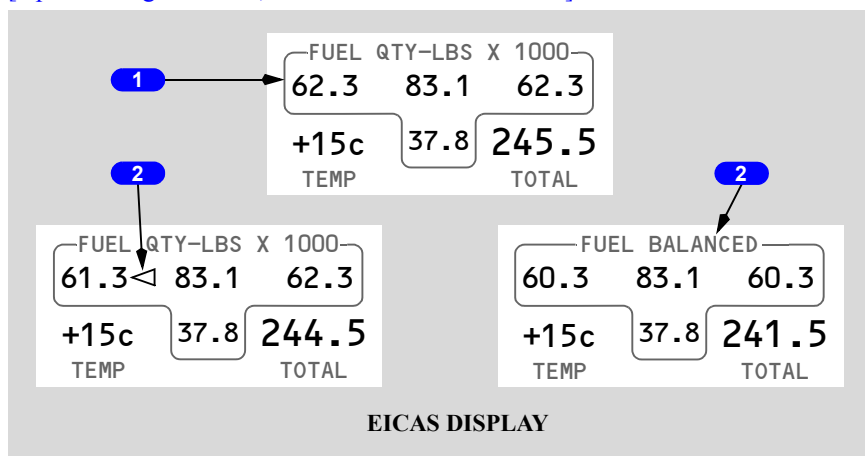
[Option - Metric Units, aux tank not installed]



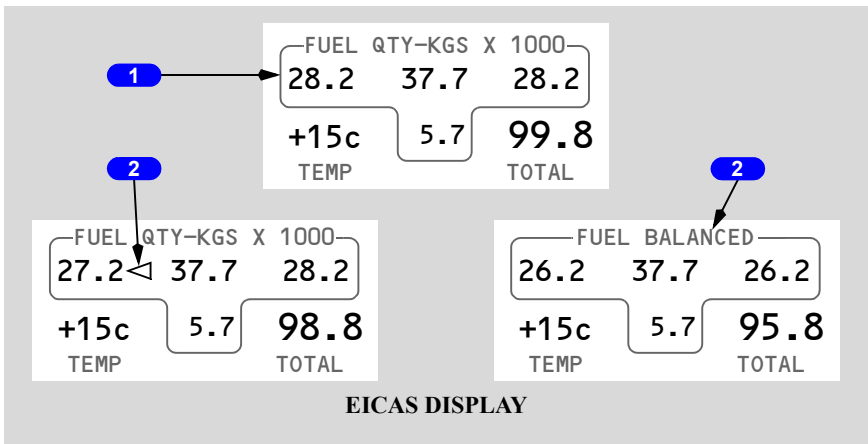
[Option - English Units, one cell aux tank installed]



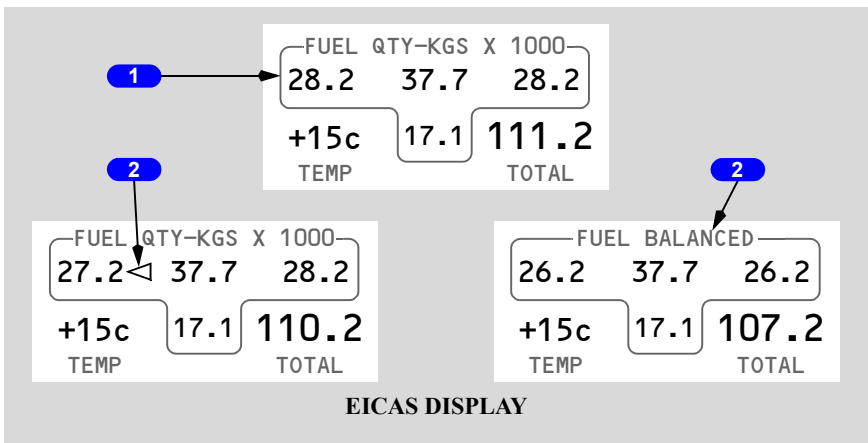
[Option - English Units, three cell aux tank installed]



[Option - Metric Units, one cell aux tank installed]



[Option - Metric Units, three cell aux tank installed]



1 Expanded Fuel Indications

The expanded FUEL QUANTITY display (left main, center, and right main tank quantities) appears for any of the following conditions:

- one or both crossfeed valves open
- one or more fuel tank quantity indications are inoperative
- the FUEL IN CENTER alert message is displayed (center tank quantity is amber)
- the FUEL QTY LOW alert message is displayed (low main tank quantity is amber)
- the FUEL IMBALANCE alert message is displayed

[AIMS05 installed]

- the airplane is on the ground and one or both engine(s) off

[Option - aux tank installed]

- the FUEL IN AUX alert message is displayed
- the FUEL AUX XFR alert message is displayed

2 Fuel Imbalance Indications

A fuel imbalance pointer is displayed on the expanded fuel quantity display next to the low tank quantity for the following imbalance conditions.

A solid white pointer is displayed if:

[Option – English Units]

- main tank fuel differs more than 1000 pounds
- main tank fuel differs more than 200 pounds and a crossfeed valve is open.

[Option – Metric Units]

- main tank fuel differs more than 500 kilograms
- main tank fuel differs more than 100 kilograms and a crossfeed valve is open.

A solid amber fuel imbalance pointer replaces the white pointer if the FUEL IMBALANCE message is displayed. The difference in fuel quantity which causes the FUEL IMBALANCE message to be displayed varies with total main tank fuel quantity.

The fuel imbalance pointer flashes if fuel balancing is going in the wrong direction.

[Option – English Units]

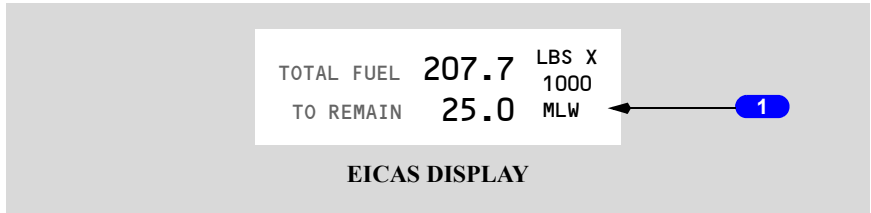
When fuel is back in balance within 200 pounds between the main tanks – FUEL BALANCED replaces FUEL QTY on the expanded fuel quantity display and flashes for 5 seconds.

[Option – Metric Units]

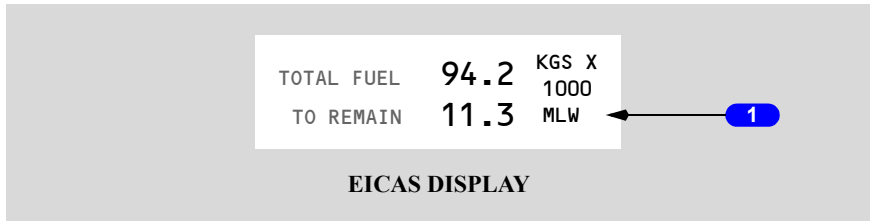
When fuel is back in balance within 100 kilograms between the main tanks – FUEL BALANCED replaces FUEL QTY on the expanded fuel quantity display and flashes for 5 seconds.

Fuel Jettison Indications

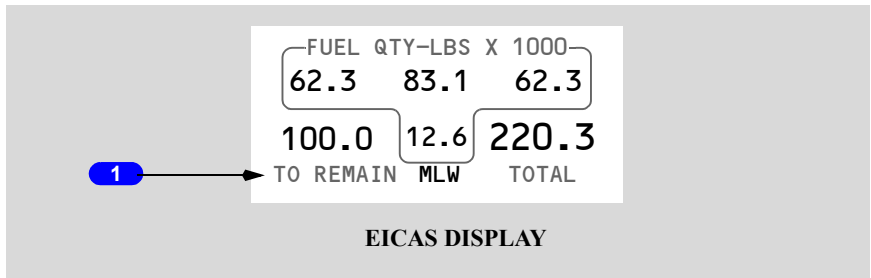
[Option – English Units, aux tank not installed]



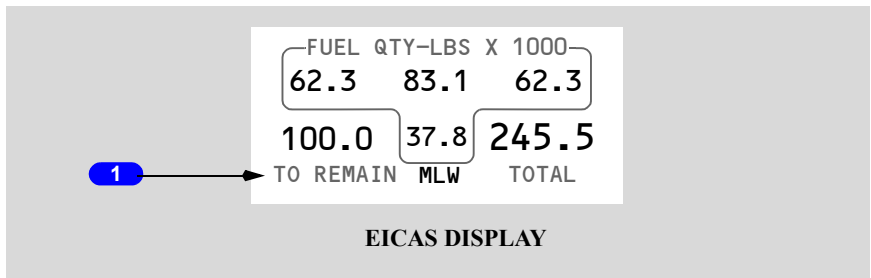
[Option – Metric Units, aux tank not installed]



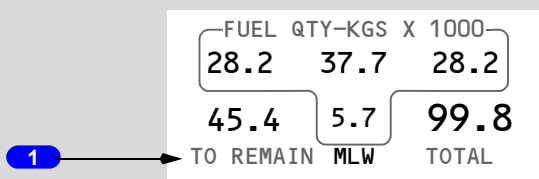
[Option - English Units, one cell aux tank installed]



[Option - English Units, three cell aux tank installed]

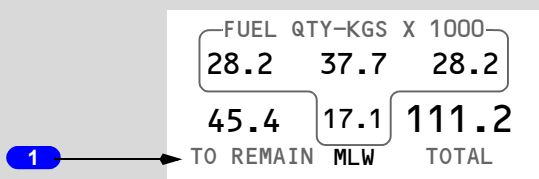


[Option - Metric Units, one cell aux tank installed]



EICAS DISPLAY

[Option - Metric Units, three cell aux tank installed]



EICAS DISPLAY

1 Fuel Jettison Indications

Fuel to remain (MLW displayed):

- fuel jettison system is ARMED
- the fuel to remain defaults to a fuel quantity that will leave the airplane at maximum landing weight when jettison is complete
- the fuel to remain display replaces the fuel temperature display.

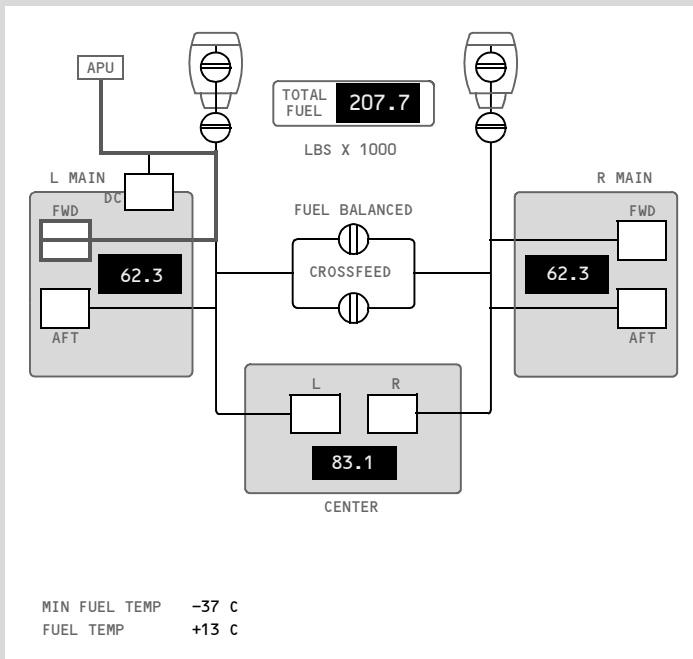
Fuel to remain (MAN displayed):

- fuel jettison system is ARMED
- the FUEL TO REMAIN selector is pulled on
- the quantity to remain can be changed by rotating the FUEL TO REMAIN selector to the slow or fast rate position.

Fuel Synoptic Display

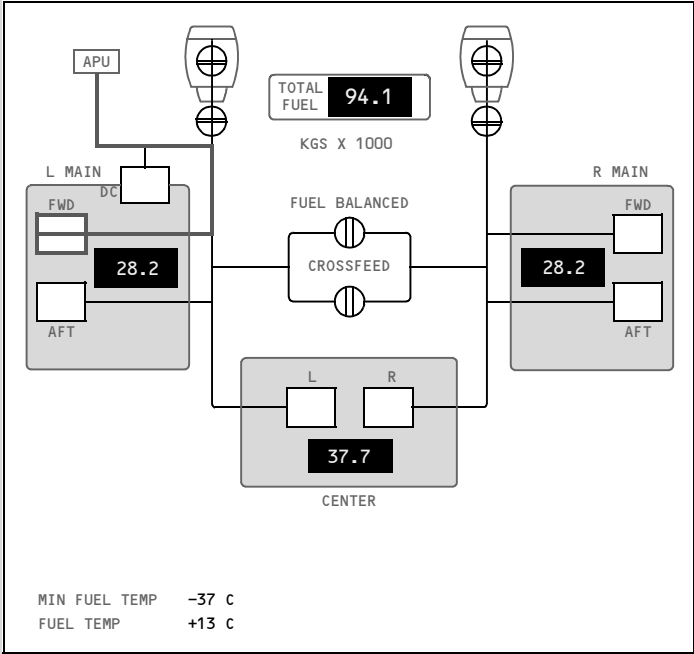
The fuel synoptic is displayed by pushing the FUEL synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

[Option - English Units, aux tank not installed]



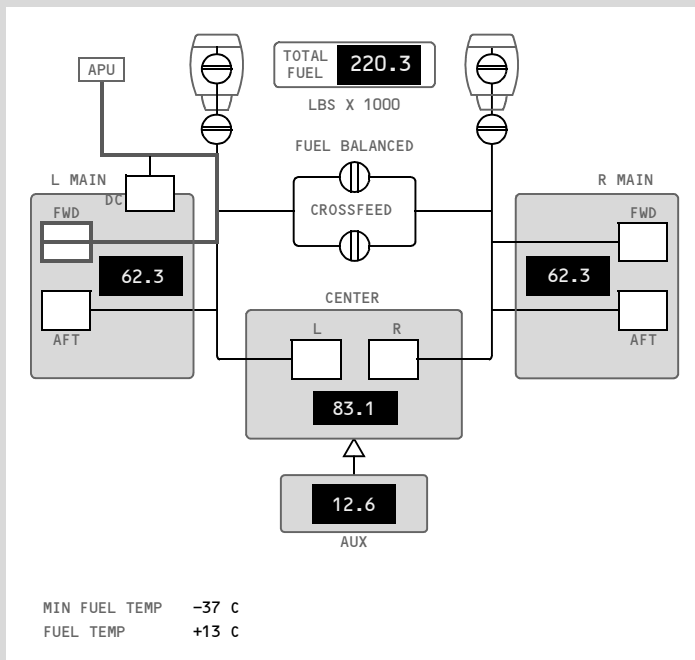
MULTIFUNCTION DISPLAY

[Option - Metric Units, aux tank not installed]



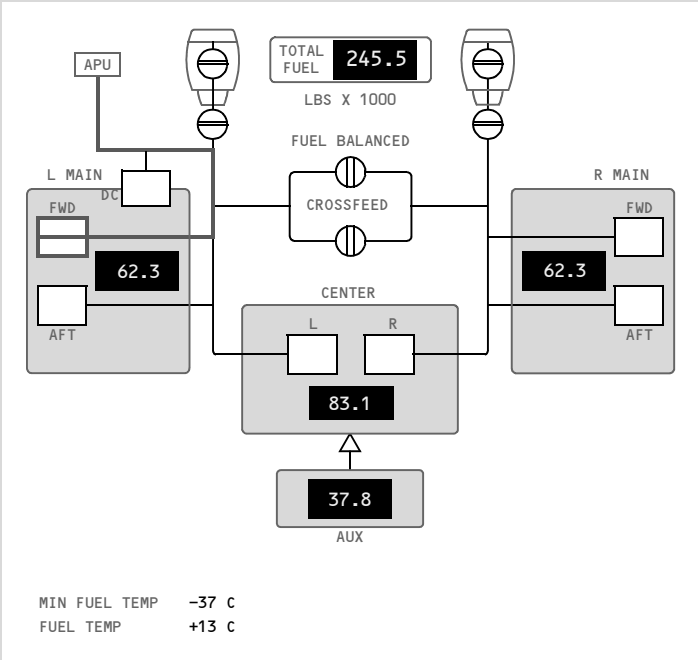
MULTIFUNCTION DISPLAY

[Option - English Units, one cell aux tank installed]



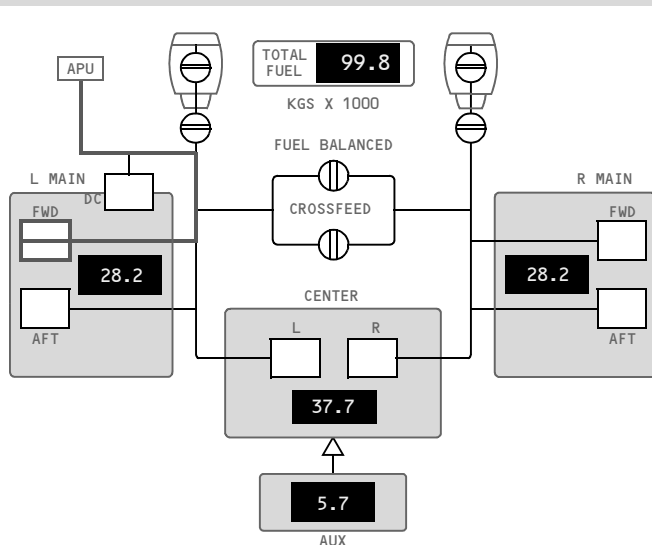
MULTIFUNCTION DISPLAY

[Option - English Units, three cell aux tank installed]



MULTIFUNCTION DISPLAY

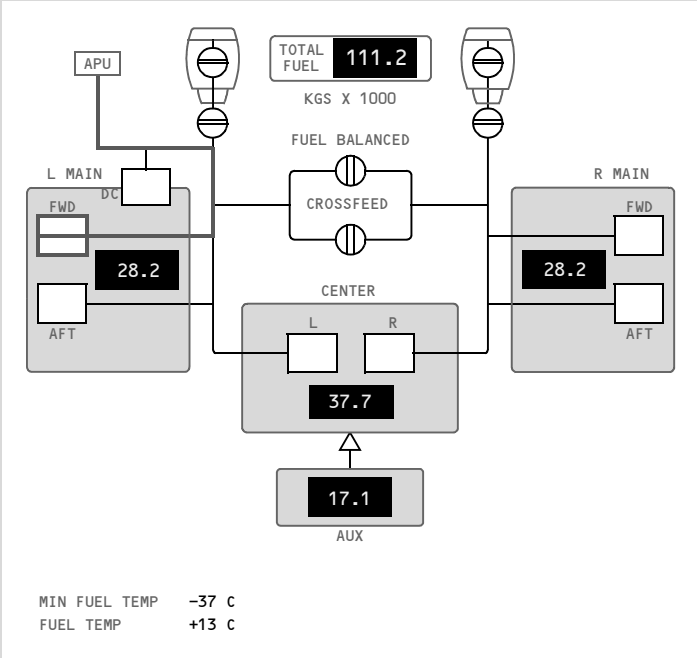
[Option - Metric Units, one cell aux tank installed]



MIN FUEL TEMP -37 C
FUEL TEMP +13 C

MULTIFUNCTION DISPLAY

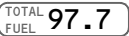
[Option - Metric Units, three cell aux tank installed]



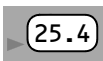
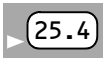
MULTIFUNCTION DISPLAY

Fuel Synoptic Indications

Symbol	Indication	Description
	Fuel Valve (white)	Fuel valve is closed.
	Fuel Valve (green)	Fuel valve is in transit.
	Fuel Valve (green)	Fuel valve is open.
	Fuel Valve (amber with crossout)	Fuel valve is failed. Valve is commanded open but remains closed.
	Fuel Valve (amber with crossout)	Fuel valve is failed. Valve is commanded closed but remains open or in transit.
	Fuel Valve (gray)	Fuel valve state is invalid.
	Fuel Pump (green rectangle)	Fuel pump is ON.
	Fuel Pump (white rectangle)	Fuel pump is OFF or invalid signal.
	Fuel Pump (amber rectangle with crossout)	Fuel pump failed or pump switch is ON and pressure sensor detects low pressure. Also shown following automatic shutoff of center tanks.

	Fuel Pump (gray rectangle)	Fuel pump state is invalid.
	Normal Fuel Feed (green)	Fuel line is pressurized.
	Suction Feed (amber)	Fuel line is unpressurized and suction flow is occurring.
	Fuel Jettison (green)	Fuel is being jettisoned.
	Total Fuel (white)	Normal indication.
	Total Fuel (blank)	Invalid indication or any individual tank quantity blank
	Main Tank Quantity (white)	Normal indication.
	Main Tank Quantity (amber)	Fuel tank quantity is low. FUEL QTY LOW message is displayed
	Tank Quantity (blank)	Tank quantity is invalid.
	Center Tank Quantity (white)	Normal indication.

777 Flight Crew Operations Manual

	Center Tank Quantity (amber)	FUEL IN CENTER message is displayed.
	Center Tank Quantity (amber)	Center fuel tank quantity is low. FUEL LOW CENTER message is displayed.
	Pointer (amber)	FUEL IMBALANCE is displayed. Points toward the main tank with the lower quantity. Flashes if fuel balancing is going the wrong direction.
	Pointer (white)	Main tank fuel differs by more than 1000 lbs (or 500 kgs), or the crossfeed switch is on and the main tank quantities differ by more than 200 lbs (or 100 kgs). Points toward the main tank with the lower quantity.
FUEL BALANCED	Fuel Balanced (white)	Balanced indication. When fuel balance is re-established, the fuel balanced indication flashes for five seconds when the fuel is within 200 lbs (or 100 kgs) of balanced.
MIN FUEL TEMP -37c	Minimum Fuel Temperature (temperature displayed white)	Normal indication. Refer to Chapter 11, Flight Management, Navigation, Section 40, for a description of Minimum Fuel Temperature.
MIN FUEL TEMP	Minimum Fuel Temperature (temperature displayed as blank)	Invalid indication.
FUEL TEMP +13c	Fuel Temperature (temperature displayed white)	Normal indication. Displays the left main tank fuel temperature.
FUEL TEMP +55c	Fuel Temperature (temperature displayed amber)	High fuel temperature indication when "+" is displayed. Low fuel temperature indication when "-" is displayed.
FUEL TEMP	Fuel Temperature (temperature displayed as blank)	Invalid indication.

[Option - aux tank installed]

Symbol	Indication	Description
	Auxiliary Tank Quantity (white)	Normal indication.
	Auxiliary Tank Quantity (amber)	AUX fuel switch is off and usable fuel remains or auxiliary fuel transfer has failed.
	Auxiliary transfer (white)	Auxiliary fuel transfer switch is ON but transfer not in progress.
	Auxiliary transfer (green)	Auxiliary fuel transfer in progress.
	Auxiliary transfer (amber)	Auxiliary fuel failed to transfer.

Fuel
System Description**Chapter 12**
Section 20

Introduction[\[Aux tank not installed\]](#)

The fuel system supplies fuel to the engines and the APU. The fuel is contained in a center tank, and left and right main tanks.

[\[Option - aux tank installed\]](#)

The fuel system supplies fuel to the engines and the APU. The fuel is contained in a center tank, left and right main tanks, and an auxiliary tank.

Refer to Chapter 7, Engines, for a description of the engine fuel system.

Fuel Quantity

Fuel quantity is measured by sensors in each tank. Total fuel quantity is displayed on the primary EICAS display. Tank quantities and total fuel quantity are displayed on the FUEL synoptic display.

[\[Aux tank not installed\]](#)

Expanded fuel indications showing the left main, center, and right main tank quantities are displayed when non-normal conditions occur.

[\[Option - aux tank installed\]](#)

Expanded fuel indications showing the left main, center, right main, and auxiliary tank quantities are displayed when non-normal conditions occur.

Fuel Temperature

Fuel temperature is displayed on the primary EICAS display. The temperature is normally displayed in white. It is displayed in amber when the fuel temperature approaches the fuel freeze temperature entered on the flight management system CDU. During jettison, the TO REMAIN quantity replaces the EICAS display fuel temperature indication.

Fuel temperature and minimum fuel temperature are also displayed on the fuel synoptic display.

Nitrogen Generation System (NGS)

The NGS converts bleed air to nitrogen-enriched air to reduce flammability of center wing tank fuel during all phases of flight and for a brief period after landing. To reduce bleed air demand NGS is shut down for engine out operation. NGS is also shut down when the Equipment Cooling switch is off or a Cargo Fire Arm switch is ARMED.

Fuel Pumps

Each fuel tank contains two AC-powered fuel pumps. A single pump can supply sufficient fuel to operate one engine under all conditions.

The two center tank fuel pumps are override/jettison pumps. These pumps have a higher output pressure than the left and right main tank fuel pumps. The center tank pumps override the main tank pumps so that center tank fuel is used before wing tank fuel. The center tank fuel pumps will shut off automatically after 15 seconds of continuous low pressure. The auto-shutoff feature is disabled during jettison.

[Aux tank not installed]

When the main tank fuel pump switches are off, the switch PRESS lights illuminate and the EICAS advisory messages FUEL PUMP (L, R, FWD, or AFT) display. When the center fuel pump switches are off, the switch PRESS lights and pump pressure EICAS messages are inhibited.

[Option - one cell aux tank installed]

The auxiliary tank contains one AC-powered fuel pump. Air pressure is used to transfer auxiliary fuel to the center tank if the AC-powered pump is inoperative.

[Option - three cell aux tank installed]

The auxiliary tank contains three AC-powered fuel pumps, one in each cell. Air pressure is used to transfer auxiliary fuel to the center tank if the AC-powered pumps are inoperative.

[Option - aux tank installed]

When the main tank fuel pump switches are off, the switch PRESS lights illuminate and the EICAS advisory messages FUEL PUMP (L, R, FWD, or AFT) display. When the center fuel pump and auxiliary switches are off, the switch PRESS lights and pump pressure EICAS messages are inhibited.

On the ground, both center fuel pumps operate only when two electrical power sources are available. With only one power source available and the center fuel pump switches on, the switch PRESS light on the non-powered side is illuminated and the pump pressure EICAS message is inhibited.

The left main tank contains a DC-powered fuel pump. It has no controls or indicators, other than the fuel synoptic display. The DC pump operates automatically to provide fuel to the APU when AC power is not available and the APU selector is ON.

Surge tanks are provided in each wing, outboard of each main tank. Fuel in the surge tanks and fuel remaining in the refueling manifold is drained into the main tanks.

Fuel Pump Operations

Before start, the main tank pump switches should all be pushed ON.

[Option – English Units, 777-200, with pump logic revision]

Before start, with center tank quantity more than 7,500 pounds, the center tank pump switches should be pushed ON.

[Option – Metric Units, 777-200, with pump logic revision]

Before start, with center tank quantity more than 3,400 kilograms, the center tank pump switches should be pushed ON.

[Option – English Units, all models except 777-200, with pump logic revision]

Before start, with center tank quantity more than 10,500 pounds, the center tank switches should be pushed ON.

[Option – Metric Units, all models except 777-200, with pump logic revision]

Before start, with center tank quantity more than 4,800 kilograms, the center tank switches should be pushed ON.

[Option - English Units, aux tank installed]

Before start, with more than 200 pounds of fuel in the aux tank, the FUEL AUX switch should be pushed ON.

[Option - Metric Units, aux tank installed]

Before start, with more than 100 kilograms of fuel in the aux tank, the FUEL AUX switch should be pushed ON.

[Option - aux tank installed]

When the auxiliary fuel has transferred to the center tank, the FUEL LOW AUX message shows.

[All models]

During flight, when the FUEL IN CENTER message displays the center tank pump switches should be pushed ON, when the FUEL LOW CENTER message displays the center tank pump switches should be pushed off. The condition statements for these messages are contained in Section 12.30, Fuel System EICAS Messages.

[\[All models\]](#)

If a center pump has low output pressure, the fuel pump switch PRESS light illuminates and the message FUEL PUMP CENTER (L or R) displays.

[\[Option – English Units, 777-200\]](#)

With the main tank pumps ON, a scavenge system operates automatically to transfer any remaining center tank fuel to the main tanks. Fuel transfer begins when either main tank quantity is less than 20,000 pounds. Center tank quantity must be below 8,500 pounds.

[\[Option – Metric Units, 777-200\]](#)

With the main tank pumps ON, a scavenge system operates automatically to transfer any remaining center tank fuel to the main tanks. Fuel transfer begins when either main tank quantity is less than 9,100 kilograms. Center tank quantity must be below 4,100 kilograms.

[\[Option – English Units, 777-200ER, and 777-300\]](#)

With the main tank pumps ON, a scavenge system operates automatically to transfer any remaining center tank fuel to the main tanks. Fuel transfer begins when either main tank quantity is less than 29,000 pounds. Center tank quantity must be below 35,000 pounds.

[\[Option – Metric Units, 777-200ER, and 777-300\]](#)

With the main tank pumps ON, a scavenge system operates automatically to transfer any remaining center tank fuel to the main tanks. Fuel transfer begins when either main tank quantity is less than 13,100 kilograms. Center tank quantity must be below 15,900 kilograms.

[\[Option – English Units, 777F, 777-200LR, and 777-300ER\]](#)

With the main tank pumps ON, a scavenge system operates automatically to transfer any remaining center tank fuel to the main tanks. Fuel transfer begins when either main tank quantity is less than 52,600 pounds. Center tank quantity must be below 35,000 pounds.

[\[Option – Metric Units, 777F, 777-200LR, and 777-300ER\]](#)

With the main tank pumps ON, a scavenge system operates automatically to transfer any remaining center tank fuel to the main tanks. Fuel transfer begins when either main tank quantity is less than 23,900 kilograms. Center tank quantity must be below 15,900 kilograms.

Suction Feed

When main tank fuel pump pressure is low, each engine can draw fuel from its corresponding main tank through a suction feed line that bypasses the pumps. As the airplane climbs, dissolved air is released from the fuel in the tank due to the decrease in air pressure. This air may collect in the suction feed line and restrict fuel flow. At high altitude, thrust deterioration or engine flameout may occur as a result of the fuel flow reduction.

The dissolved air in the fuel tank will eventually deplete after reaching cruise altitude. The depletion time is dependent upon airplane altitude, fuel temperature, and type of fuel. Once the dissolved air is depleted, the engine should effectively operate on suction feed.

Fuel pressure can be provided from a main tank with operating fuel pumps to both engines by opening the fuel crossfeed valve(s). Continued crossfeed use will result in a progressive fuel imbalance.

Fuel Crossfeed

The fuel manifolds are arranged so that any fuel tank pump can supply either engine. The crossfeed valves are closed during normal operations. The closed crossfeed valves isolate the left and right systems. Either valve can be opened to feed an engine from the opposite fuel tank. If the valve position does not agree with the switch position, the CROSSFEED switch VALVE light illuminates and the EICAS advisory message FUEL CROSSFEED FWD or AFT displays.

Fuel Imbalance

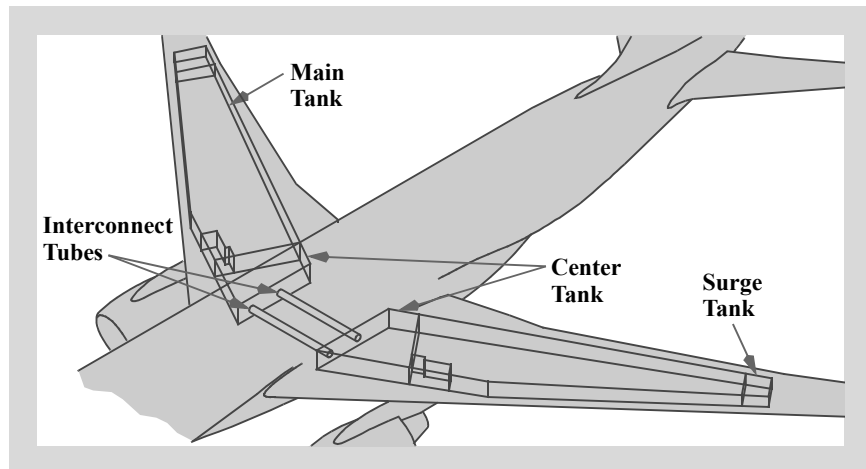
When the fuel quantity in left and right main tanks differ by an excessive quantity, the EICAS alert message FUEL IMBALANCE displays.

Fuel balancing is accomplished by opening either crossfeed valve and turning off the fuel pump switches for the fuel tank that has the lowest quantity. Fuel balancing may be done in any phase of flight.

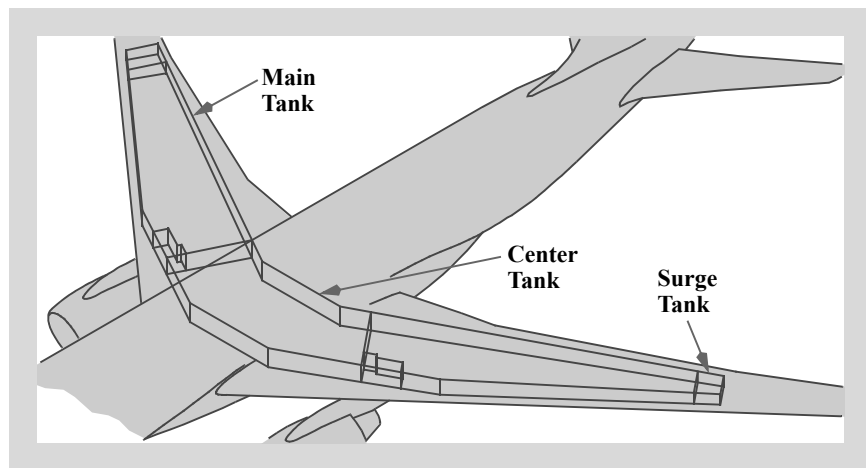
Fuel Tank Locations and Capacities

Fuel Tank Locations

[777-200]

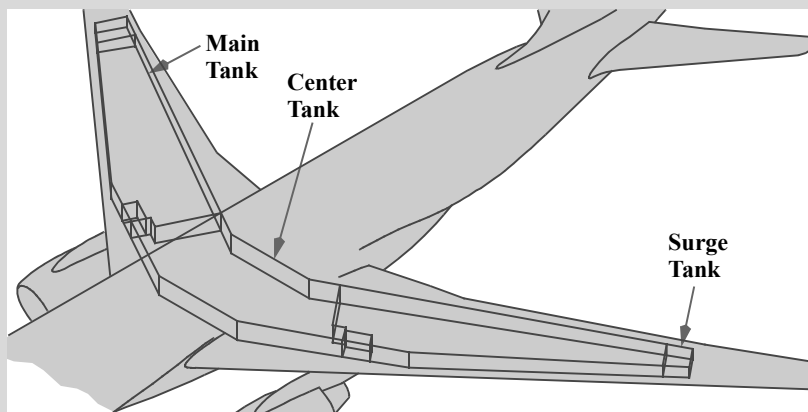


[777-200ER and 777-300]

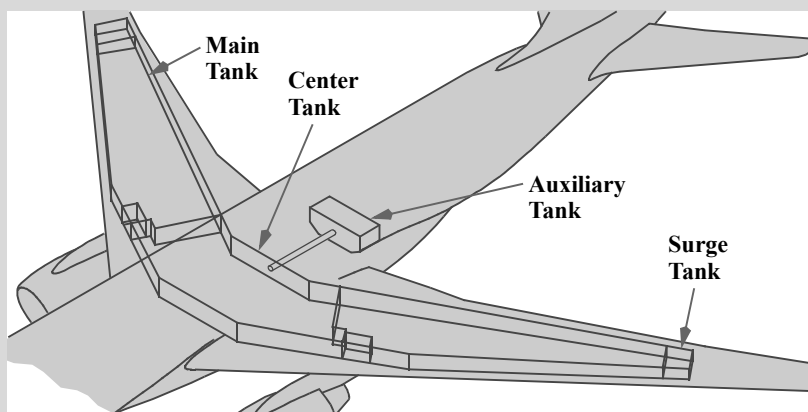


777 Flight Crew Operations Manual

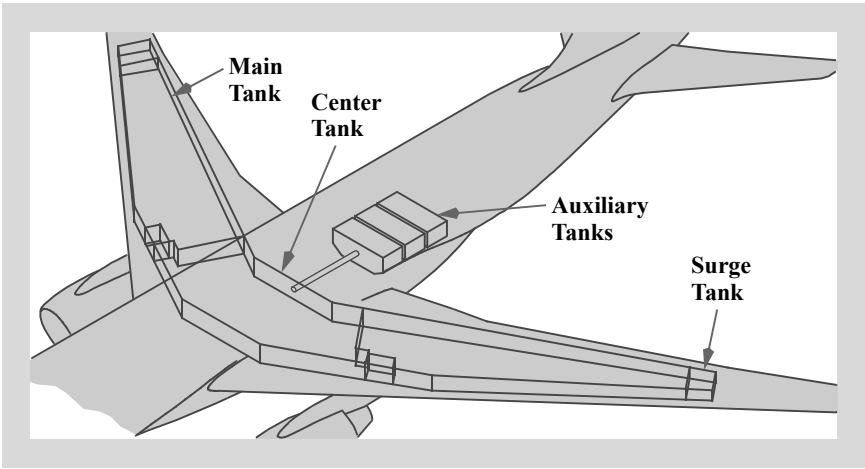
[777F, 777-200LR w/o aux tank, and 777-300ER]



[777-200LR, one cell aux tank installed]



[777-200LR, three cell aux tank installed]



Fuel Tank Capacities

[Option – English Units, 777-200]

Tank	Gallons	Pounds *
Left Main	9,300	62,300
Right Main	9,300	62,300
Center	12,400	83,100
Total	31,000	207,700
* Usable fuel at level attitude, fuel density = 6.7 pounds per US gallon.		

[Option – Metric Units, 777-200]

Tank	Liters	Kilograms *
Left Main	35,200	28,300
Right Main	35,200	28,300
Center	46,900	37,700
Total	117,300	94,300
* Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.		

777 Flight Crew Operations Manual

[Option – English Units, 777-200ER and 777-300]

Tank	Gallons	Pounds *
Left Main	9,560	64,100
Right Main	9,560	64,100
Center	26,100	174,900
Total	45,220	303,100
*Usable fuel at level attitude, fuel density = 6.7 pounds per US gallon.		

[Option – Metric Units, 777-200ER and 777-300]

Tank	Liters	Kilograms *
Left Main	36,200	29,100
Right Main	36,200	29,100
Center	98,790	79,300
Total	171,190	137,500
* Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.		

[Option – English Units, 777F, 777-200LR w/o aux tank, and 777-300ER]

Tank	Gallons	Pounds *
Left Main	10,300	69,000
Right Main	10,300	69,000
Center	27,290	182,800
Total	47,890	320,800
*Usable fuel at level attitude, fuel density = 6.7 pounds per US gallon.		

[Option – Metric Units, 777F, 777-200LR w/o aux tank, and 777-300ER]

Tank	Liters	Kilograms *
Left Main	38,990	31,300
Right Main	38,990	31,300
Center	103,290	82,900
Total	181,270	145,500
* Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.		

[Option – English Units, 777-200LR with one cell aux tank]

Tank	Gallons	Pounds *
Left Main	10,300	69,000
Right Main	10,300	69,000
Center	27,290	182,800
Auxiliary	1,875	12,600
Total	49,765	333,400
*Usable fuel at level attitude, fuel density = 6.7 pounds per US gallon.		

[Option – English Units, 777-200LR with three cell aux tank]

Tank	Gallons	Pounds *
Left Main	10,300	69,000
Right Main	10,300	69,000
Center	27,290	182,800
Auxiliary	5,625	37,700
Total	53,515	358,500
*Usable fuel at level attitude, fuel density = 6.7 pounds per US gallon.		

[Option – Metric Units, 777-200LR with one cell aux tank]

Tank	Liters	Kilograms *
Left Main	38,990	31,300
Right Main	38,990	31,300
Center	103,290	82,900
Auxiliary	7,100	5,700
Total	188,370	151,200
* Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.		

777 Flight Crew Operations Manual

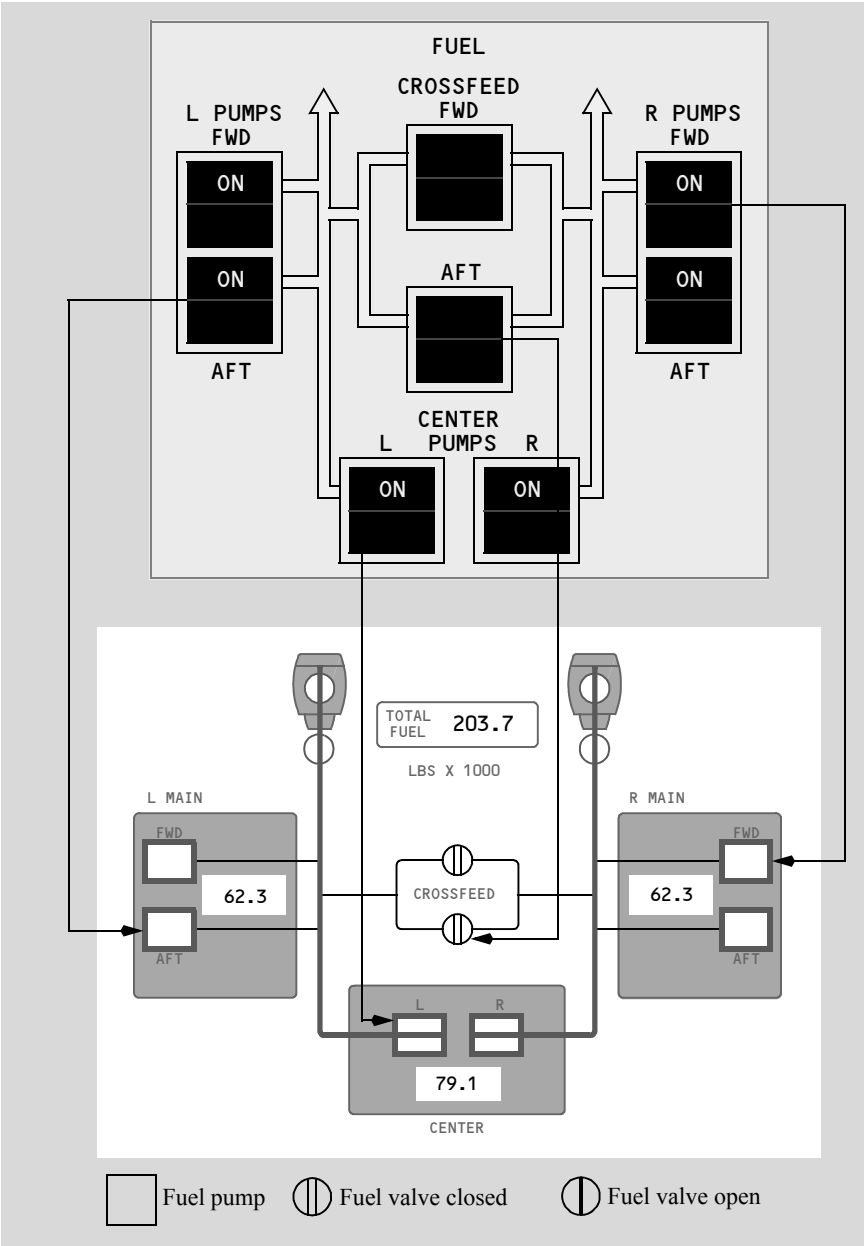
[Option – Metric Units, 777-200LR with three cell aux tank]

Tank	Liters	Kilograms *
Left Main	38,990	31,300
Right Main	38,990	31,300
Center	103,290	82,900
Auxiliary	21,300	17,100
Total	202,570	162,600

* Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.

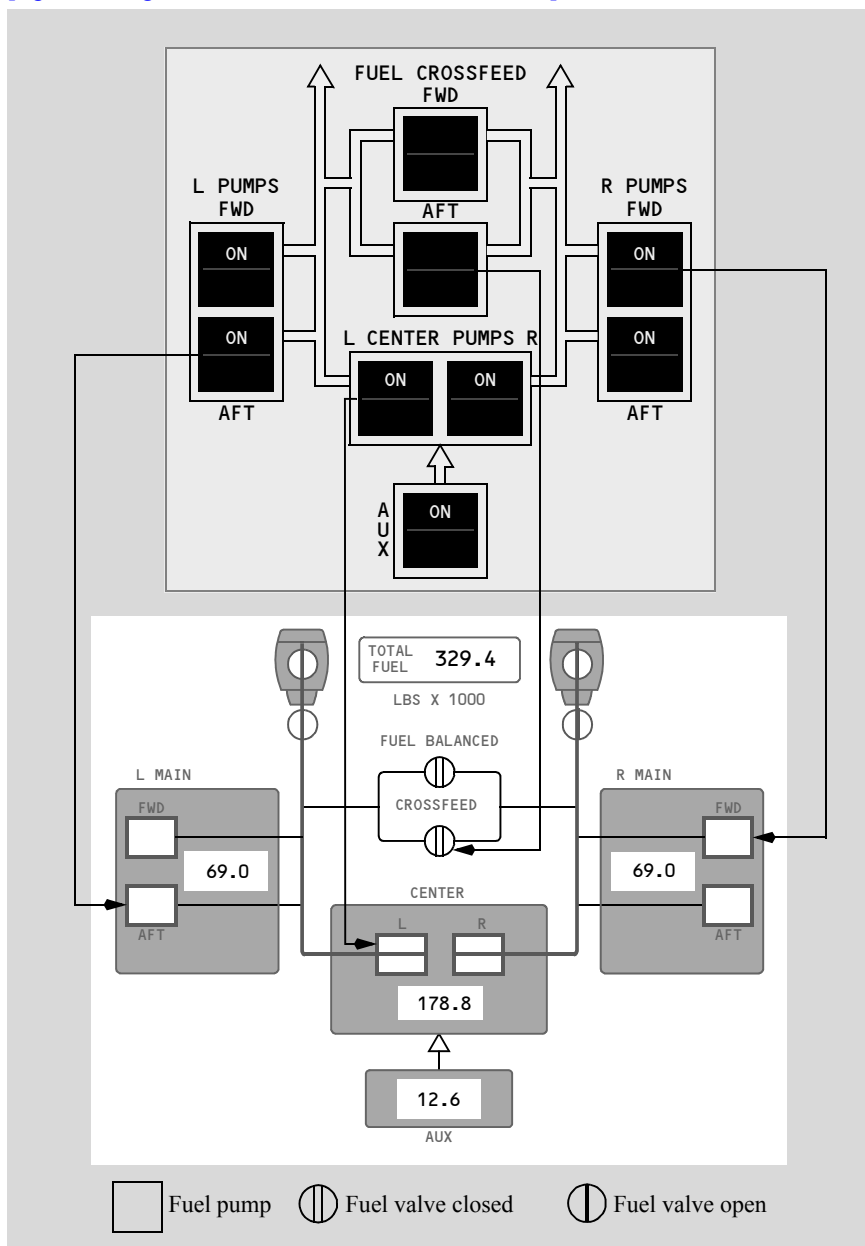
Fuel System Schematic

[Option - English Units, aux tank not installed]

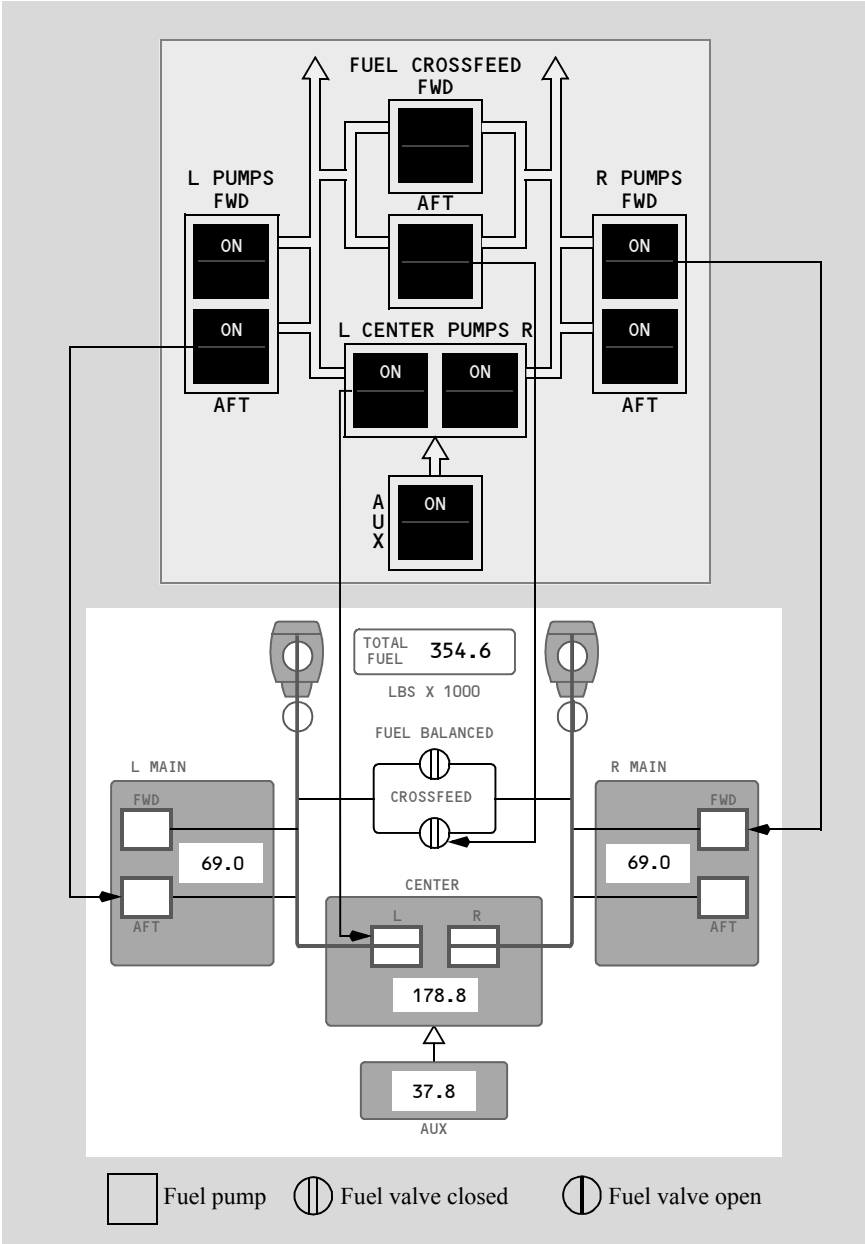


777 Flight Crew Operations Manual

[Option - English Units, one cell aux tank installed]

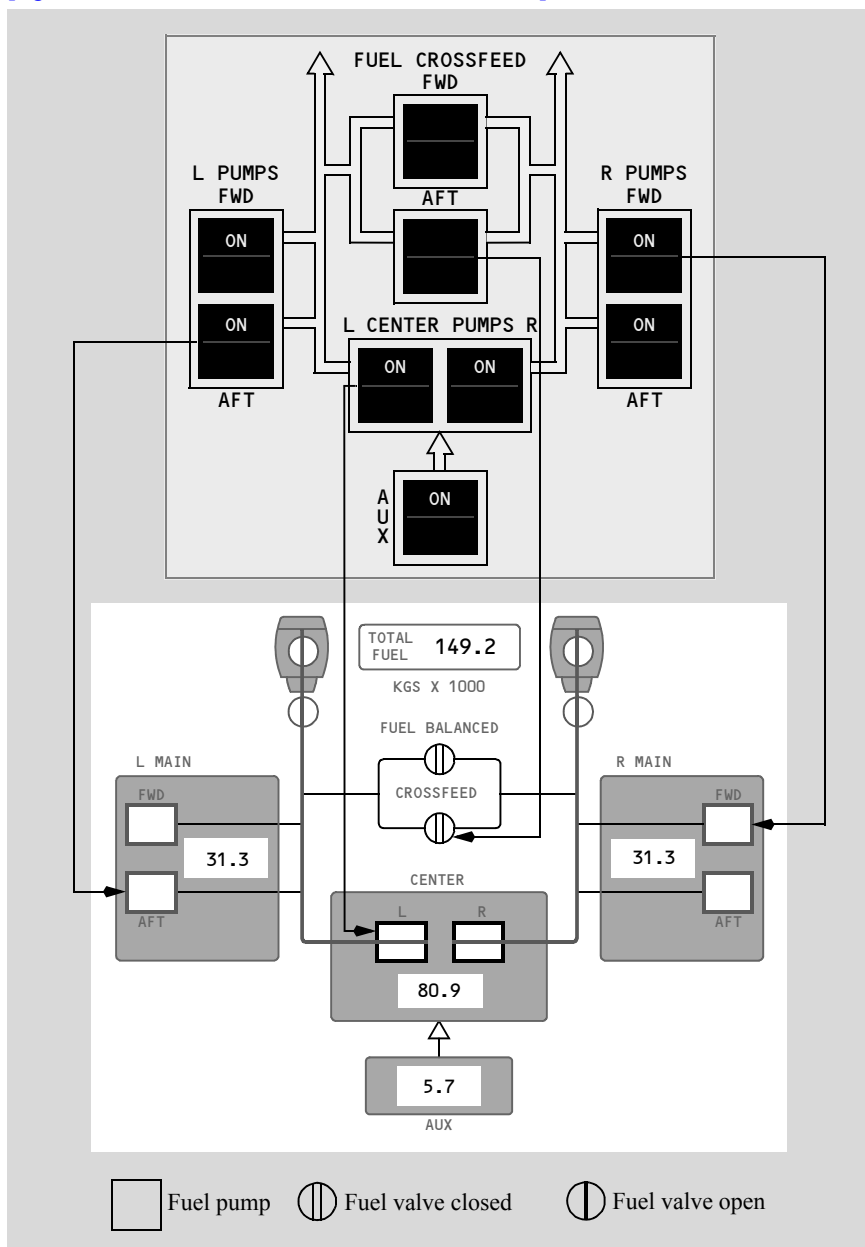


[Option - English Units, three cell aux tank installed]

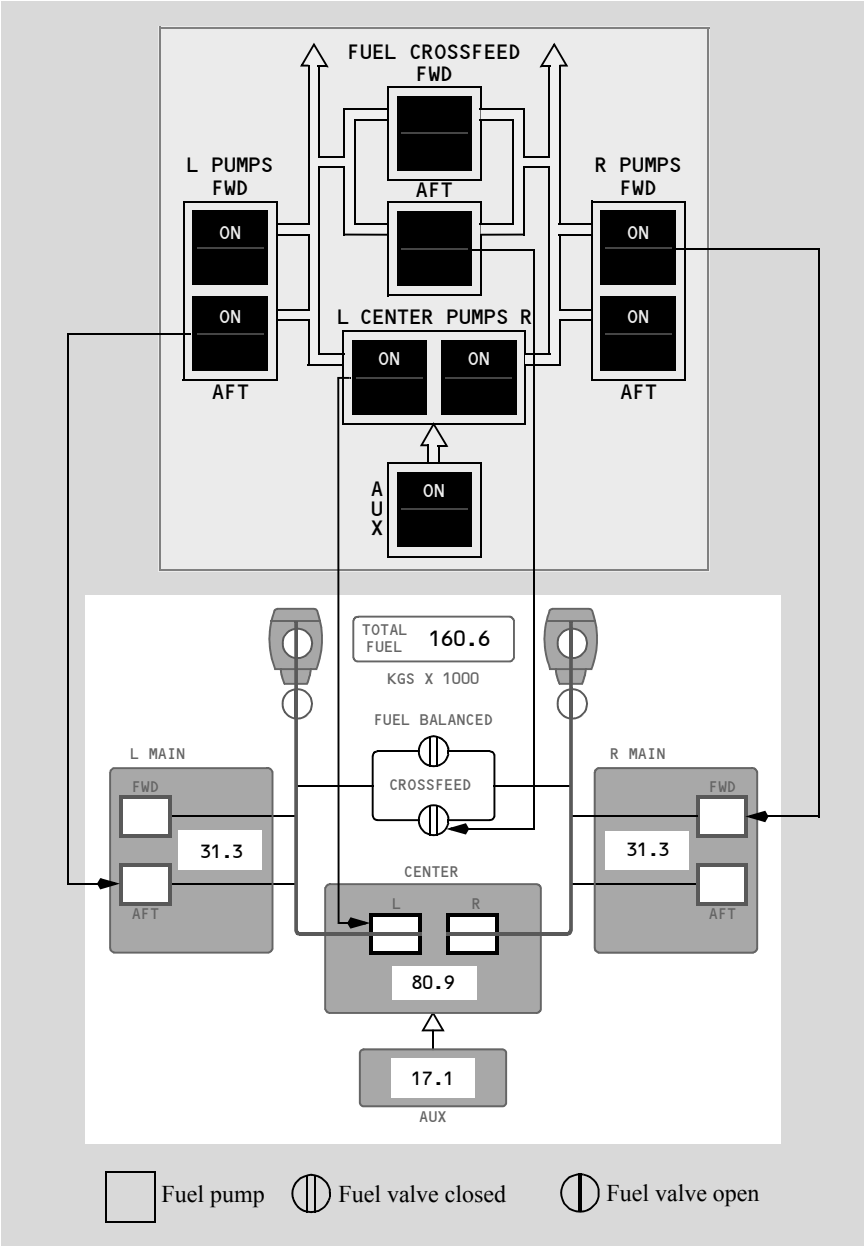


777 Flight Crew Operations Manual

[Option - Metric Units, one cell aux tank installed]



[Option - Metric Units, three cell aux tank installed]



APU Fuel Feed

APU fuel is supplied from the left fuel manifold. APU fuel can be provided by any AC fuel pump supplying fuel to the left fuel manifold or by the left main tank DC fuel pump.

On the ground, with the APU switch ON and no AC power available, the DC pump runs automatically. With AC power available, the left forward AC fuel pump operates automatically, regardless of fuel pump switch position, and the DC fuel pump turns off.

In flight, the DC fuel pump operates automatically for quick left engine relight with the loss of both engines and all AC power.

Fuel Jettison

The fuel jettison system allows jettison from all fuel tanks. Fuel is jettisoned through jettison nozzle valves inboard of each aileron. Jettison pumps in the main tanks and override/jettison pumps in the center tank pump fuel overboard through the jettison nozzle valves.

Fuel jettison is initiated by pushing the FUEL JETTISON ARM switch to select ARMED. The jettison system automatically sets the fuel-to-remain to the MLW fuel quantity. The TO REMAIN quantity replaces fuel temperature on the EICAS display.

Pull on and rotate the FUEL TO REMAIN selector to manually decrease or increase the TO REMAIN quantity.

Main tank jettison begins when:

- the FUEL JETTISON NOZZLE switches are pushed ON
- the jettison nozzle valves open, and
- the main tank jettison pumps operate.

If the center tank override/jettison pumps are on, center tank fuel also jettisons. Center tank fuel will not jettison if the center tank override/jettison pumps are off.

The nozzles cannot open on the ground, regardless of switch positions.

In flight, jettison time is displayed in minutes on the fuel synoptic when the jettison arm switch is positioned on while in the air. Jettison automatically stops when a value just above the TO REMAIN quantity is reached. The system shuts off the main tank jettison pumps and closes the center tank jettison isolation valves.

[777-200ER, 777F, 777-200LR, 777-300, and 777-300ER]

When the airplane is heavy and loaded near the forward CG, fuel is jettisoned from the center tank first to keep CG within limits; main tank jettison pump operation is delayed. The computed jettison time is automatically adjusted to reflect the increased jettison time.

[Option - aux tank installed]

Fuel jettison does not occur directly from the auxiliary tank. Auxiliary fuel is transferred to the center tank where it may be jettisoned. Auxiliary tank transfer is inhibited during jettison if necessary to help avoid an undesirable forward CG shift.

[Option – English Units]

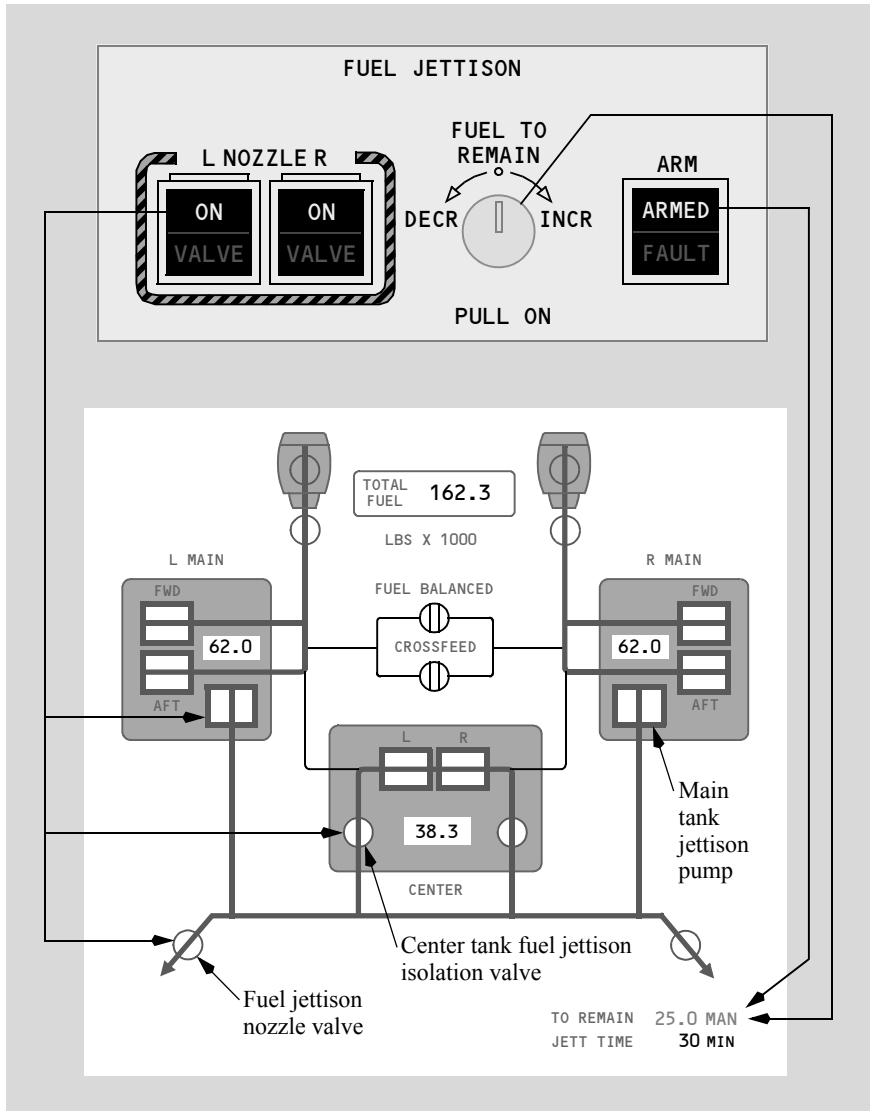
At least 11,500 pounds of fuel remains in each main tank after jettison is complete.

[Option – Metric Units]

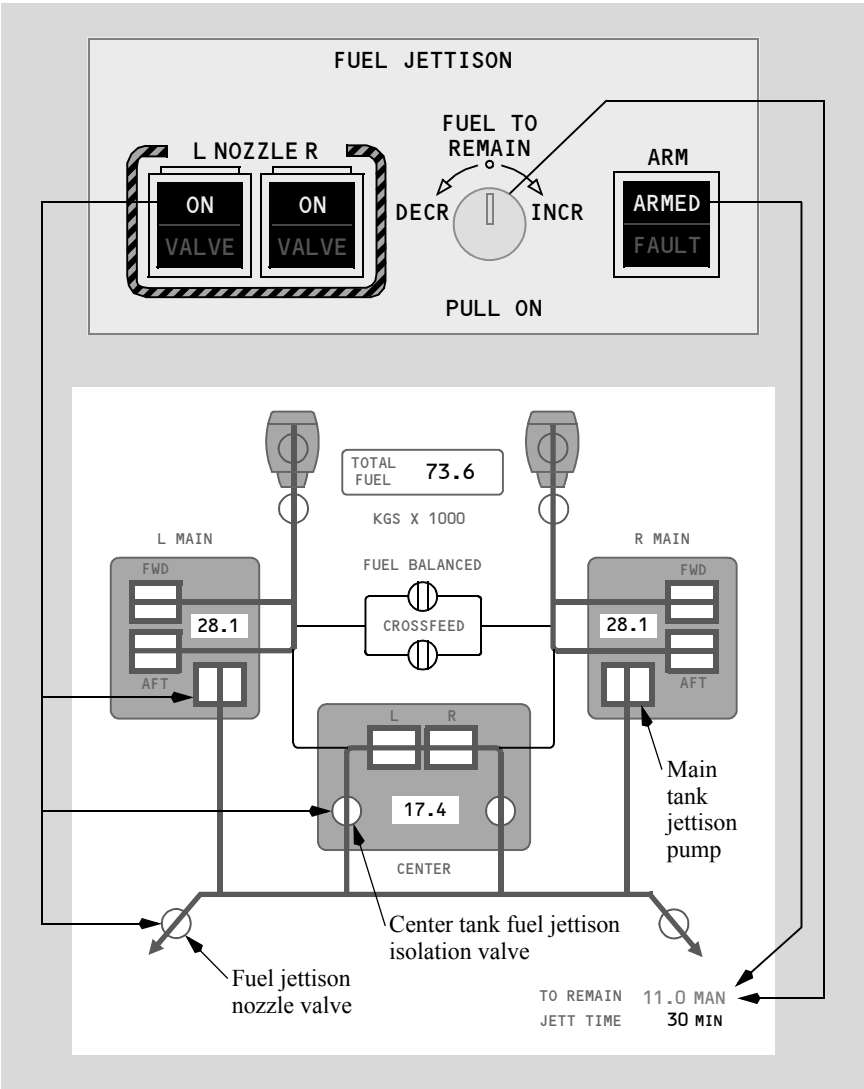
At least 5,200 kilograms of fuel remains in each main tank after jettison is complete.

Fuel Jettison Schematic

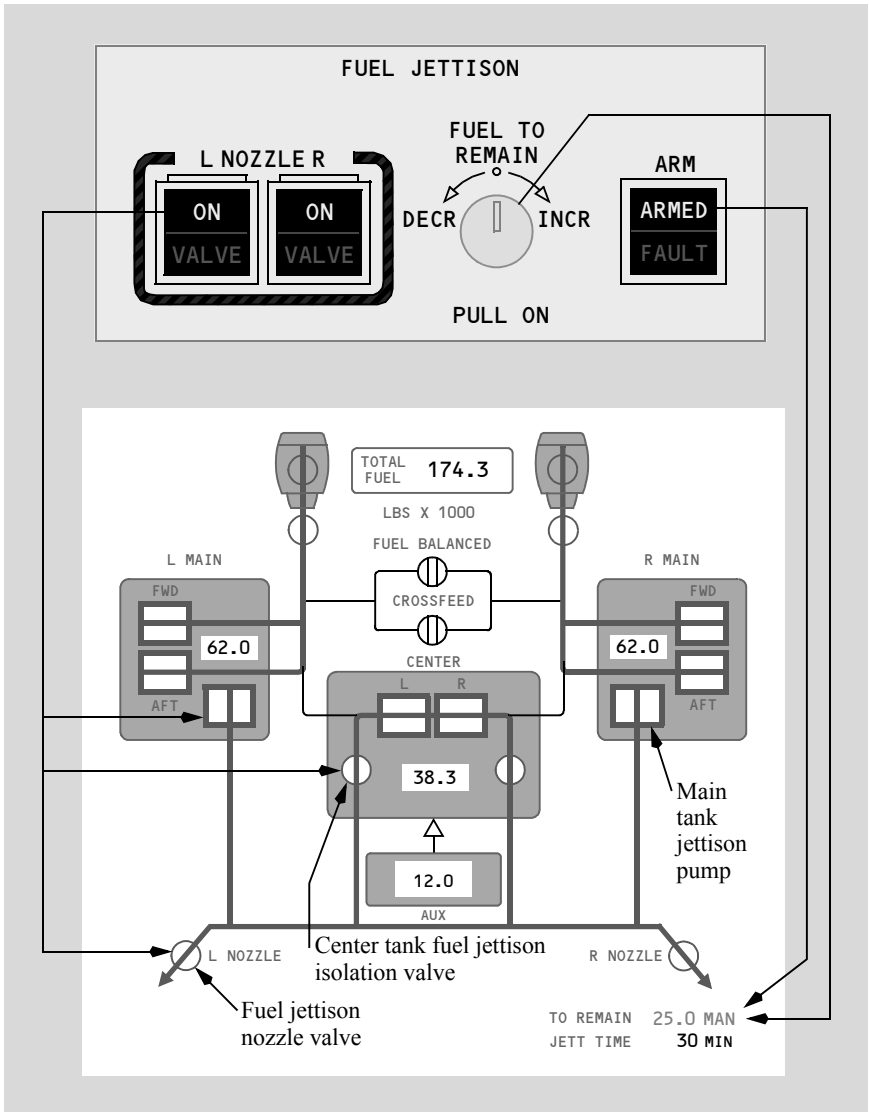
[Option - English Units, aux tank not installed]



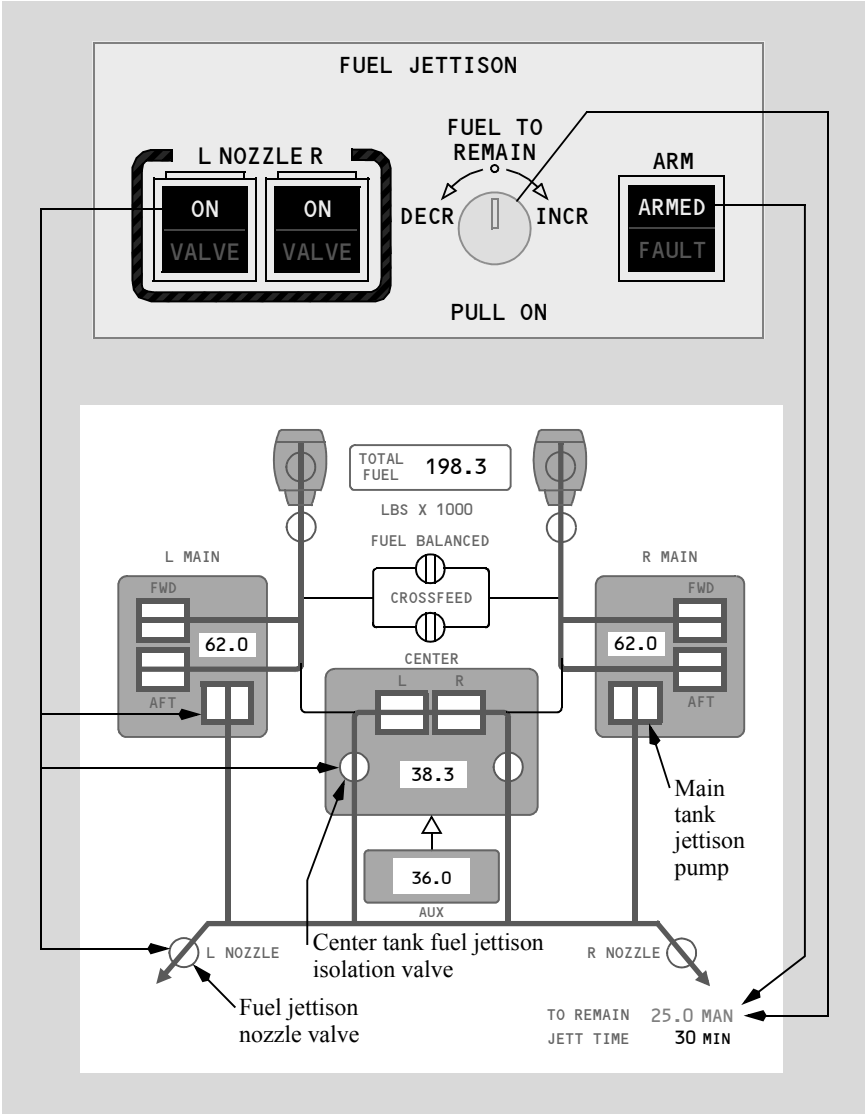
[Option - Metric Units, aux tank not installed]



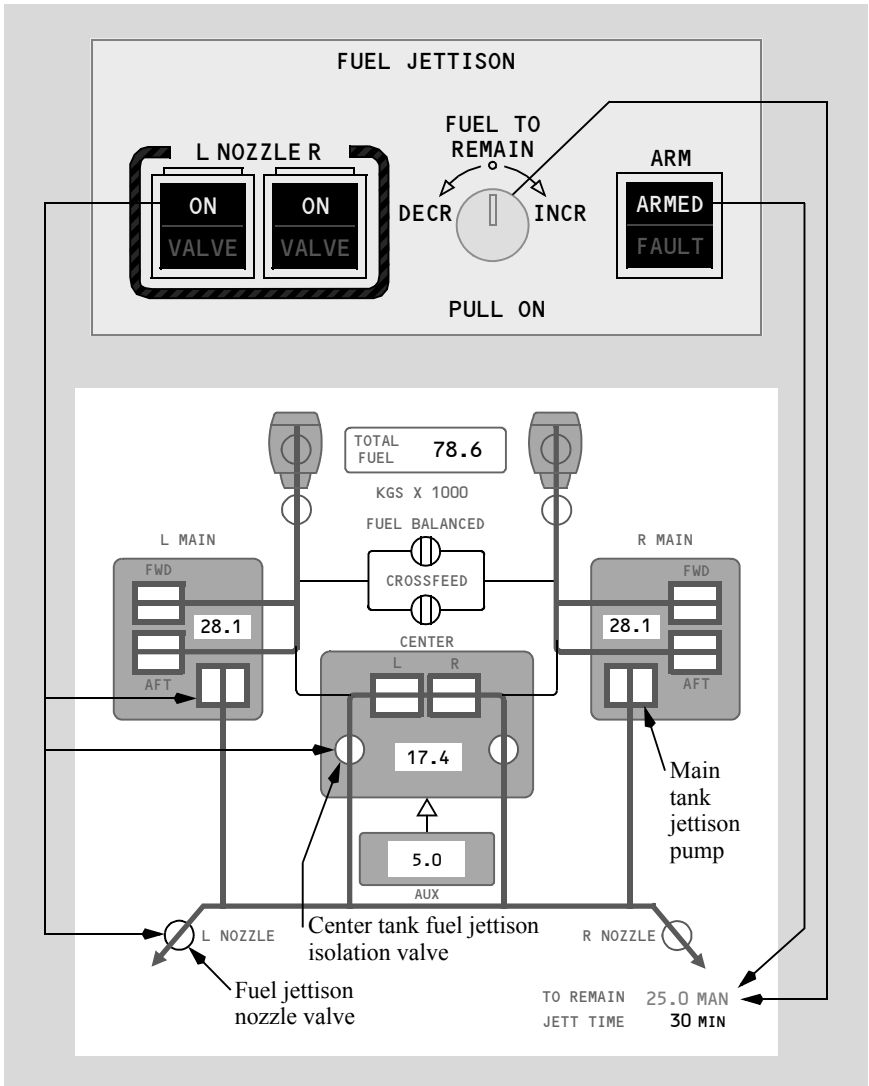
[Option - English Units, one cell aux tank installed]



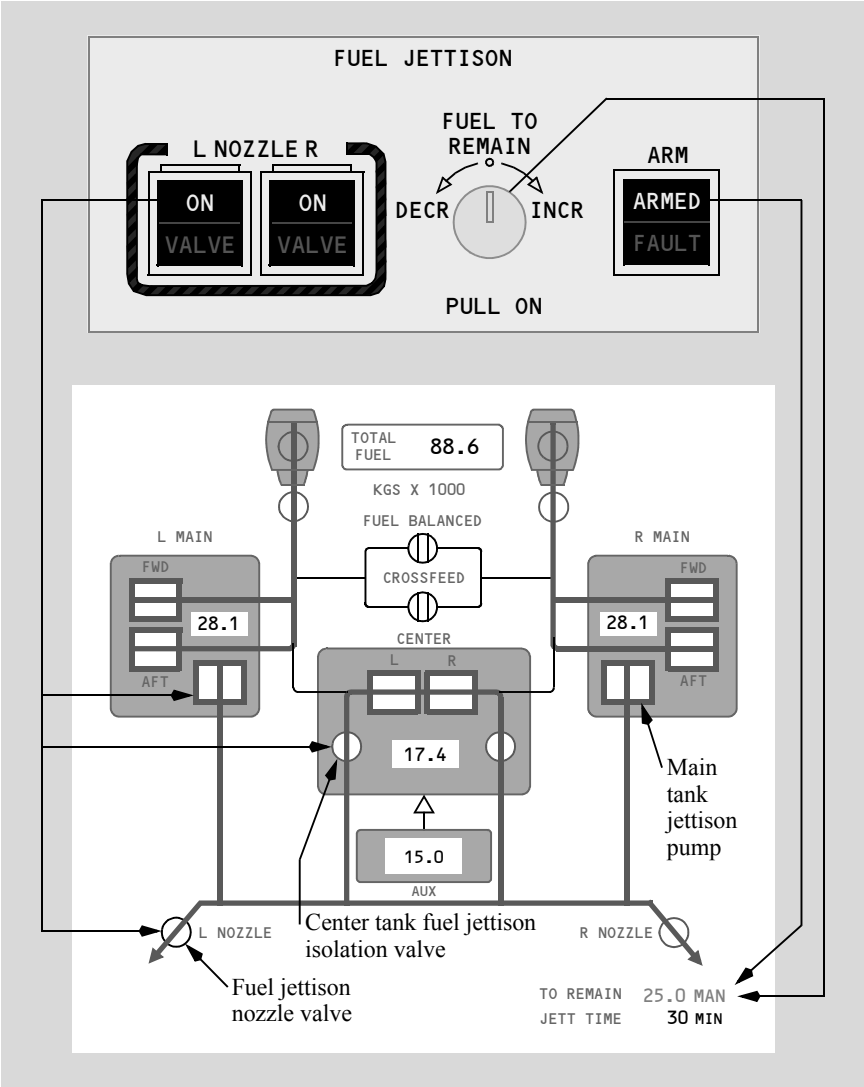
[Option - English Units, three cell aux tank installed]



[Option - Metric Units, one cell aux tank installed]



[Option - Metric Units, three cell aux tank installed]



Fuel
EICAS Messages**Chapter 12**
Section 30**Fuel System FMS CDU Messages**

The CDU can display the following messages.

INSUFFICIENT FUEL – Predicted fuel at destination is less than the FMC pilot–entered or uplinked reserves.

Fuel System EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Aural	Message Logic
FUEL AUTO JETTISON	Caution	Beeper	Fuel jettison automatic shutoff has failed, or total fuel quantity is less than selected TO REMAIN quantity and a nozzle valve is open.

[\[777-200LR Aux Tank\]](#)

FUEL AUX XFR	Caution	Beeper	Auxiliary fuel fails to transfer or is transferring slower than normal.
--------------	---------	--------	---

FUEL CROSSFEED AFT, FWD	Advisory		Crossfeed valve is not in the commanded position.
-------------------------	----------	--	---

[\[AIMS05 installed\]](#)

FUEL DISAGREE	Advisory		Totalizer fuel quantity and FMC calculated fuel quantity disagree.
---------------	----------	--	--

FUEL IMBALANCE	Advisory		Fuel imbalance between the main tanks is excessive.
----------------	----------	--	---

[\[777-200LR Aux Tank\]](#)

FUEL IN AUX	Advisory		Auxiliary fuel switch is OFF with fuel in the auxiliary tank.
-------------	----------	--	---

FUEL IN CENTER	Advisory		Both center fuel pump switches are OFF with fuel in the center tank.
----------------	----------	--	--

Message	Level	Aural	Message Logic
FUEL JETT NOZZLE L, R	Advisory		Jettison nozzle valve in not in the commanded position.
FUEL JETTISON MAIN	Advisory		Fuel jettison from the main tanks is inoperative.
FUEL JETTISON SYS	Caution	Beeper	Fuel jettison system is inoperative.

[777-200LR Aux Tank]

FUEL LOW AUX	Advisory		Auxiliary fuel switch is ON and the auxiliary tank quantity is low.
--------------	----------	--	---

FUEL LOW CENTER	Advisory		One or both center fuel pump switches are ON and center tank quantity is low.
FUEL PRESS ENG L, R	Caution	Beeper	Engine is on suction feed.
FUEL PRESS ENG L+R	Advisory		All fuel pump output pressures are low.
FUEL PUMP CENTER L, R	Advisory		Center fuel pump output pressure is low.
FUEL PUMP L AFT, FWD	Advisory		Left aft or forward fuel pump output pressure is low.
FUEL PUMP R AFT, FWD	Advisory		Right aft or forward fuel pump output pressure is low.
FUEL QTY LOW	Caution	Beeper	Fuel quantity is low in either main tank.

[777-200, 777-200ER and 777-300]

[English Units and AIMS V14 installed]

FUEL SCAVENGE SYS	Advisory		Either main tank is less than 14,000 lbs and the center tank quantity is less than 500 lbs for 15 minutes.
----------------------	----------	--	--

[777-200, 777-200ER and 777-300]

[Metric Units and AIMS V14 installed]

FUEL SCAVENGE SYS	Advisory		Either main tank is less than 6,400 kgs and the center tank quantity is less than 200 kgs for 15 minutes.
----------------------	----------	--	---

777 Flight Crew Operations Manual

Message	Level	Aural	Message Logic
---------	-------	-------	---------------

[777F, 777-200LR and 777-300ER]
[English Units and AIMS V14 installed]

FUEL SCAVENGE SYS	Advisory		Either main tank is less than 18,000 lbs and the center tank quantity is greater than 500 lbs for 15 minutes.
----------------------	----------	--	---

[777F, 777-200LR and 777-300ER]
[Metric Units and AIMS V14 installed]

FUEL SCAVENGE SYS	Advisory		Either main tank is less than 8,200 kgs and the center tank quantity is greater than 200 kgs for 15 minutes.
----------------------	----------	--	--

FUEL TEMP LOW	Advisory		Fuel temperature is approaching minimum.
FUEL VALVE APU	Advisory		APU fuel valve is not in the commanded position.

Intentionally
Blank

Hydraulics**Chapter 13****Table of Contents****Section 0**

Controls and Indicators	13.10
Hydraulic Panel	13.10.1
Hydraulic System Indications	13.10.3
Status Display	13.10.3
Hydraulic Synoptic Display	13.10.4
Miscellaneous Hydraulic System Controls	13.10.5
Engine Fire Panel	13.10.5
Flight Control Hydraulic Power Switches	13.10.5
System Description	13.20
Introduction	13.20.1
Left and Right Hydraulic Systems	13.20.1
Left and Right Hydraulic System Primary Pumps	13.20.1
Left and Right Hydraulic System Demand Pumps	13.20.1
Center Hydraulic System	13.20.2
Center Hydraulic System Primary Pumps	13.20.2
Center Hydraulic System Demand Pumps	13.20.2
Center Hydraulic System Non–Normal Operation	13.20.3
Ram Air Turbine (RAT)	13.20.3
Hydraulic Systems Schematic	13.20.4
EICAS Messages	13.30
Hydraulics, Ram Air Turbine EICAS Messages	13.30.1

Intentionally
Blank

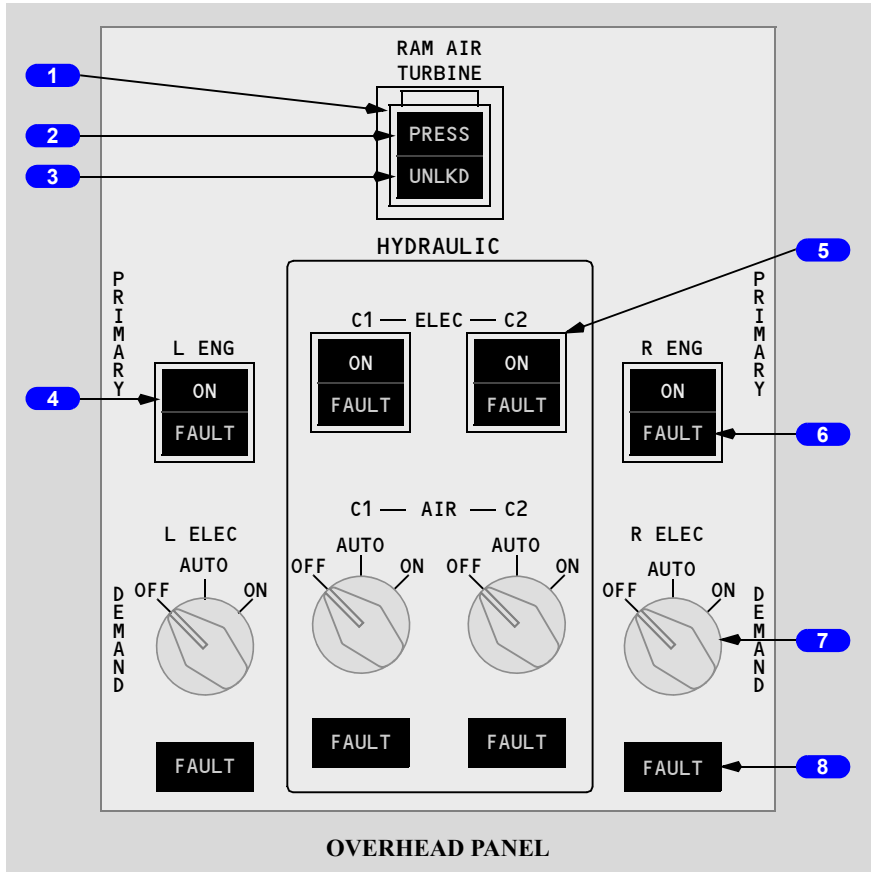
Hydraulics

Controls and Indicators

Chapter 13

Section 10

Hydraulic Panel



1 RAM AIR TURBINE (RAT) Switch

Push – deploys the RAT.

2 Ram Air Turbine Pressure (PRESS) Light

Illuminated (green) –

- the RAT is deployed
- center system primary flight control hydraulic pressure is greater than 1500 psi

3 Ram Air Turbine Unlocked (UNLKD) Light

Illuminated (amber) – the RAT is not in the stowed position.

4 Left/Right Engine (L/R ENG) PRIMARY Pump Switches

ON – the engine–driven hydraulic pump pressurizes the related left or right hydraulic system when the engine rotates.

Off (ON not visible) – the engine–driven hydraulic pump is turned off and depressurized.

5 C1/C2 Electrical (C1/C2 ELEC) PRIMARY Pump Switches

ON –

- the electric motor–driven hydraulic pump operates
- pressurizes the center hydraulic system

Off (ON not visible) – the electric motor–driven hydraulic pump is turned off.

6 Primary Pump FAULT Lights

Illuminated (amber) –

- low primary pump pressure
- excessive primary pump fluid temperature, or
- pump selected OFF

7 DEMAND Pump Selectors

ON – the pump runs continuously.

AUTO – the pump operates when system and/or primary pump(s) pressure is low, or when control logic anticipates a large system demand.

OFF – the pump is off.

Note: If both air–driven pumps are selected to ON, only air–driven pump C1 operates; the two air–driven pumps cannot operate simultaneously when both are selected ON.

8 Demand Pump FAULT Lights

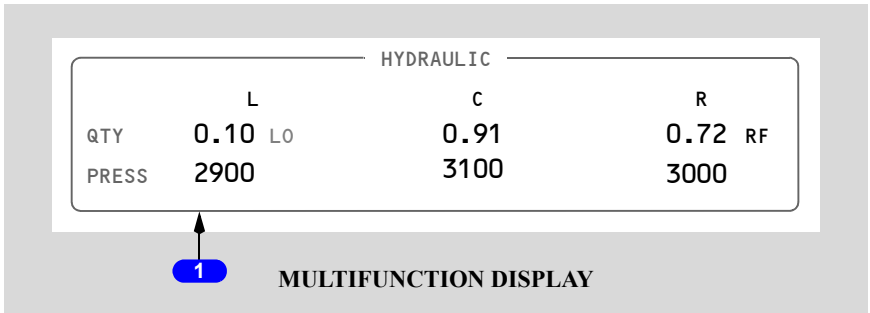
Illuminated (amber) –

- low demand pump output pressure
- excessive demand pump fluid temperature, or
- demand pump is selected OFF

Hydraulic System Indications

To view the status display, push the STAT display switch on the display select panel. To view the hydraulic synoptic, push the HYD synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

Status Display



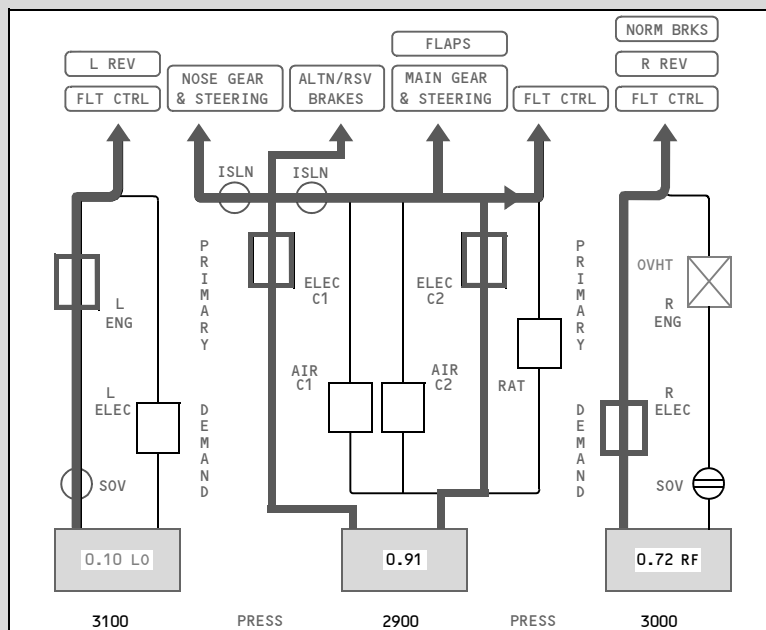
1 Hydraulic Display

QTY –

- displays system reservoir quantity as a percentage of the normal service level (1.00 is the normal service level)
- LO (amber) – displayed when the reservoir quantity is low
- OF (white) – displayed when the reservoir is over–full (inhibited in flight)
- RF (white) – displayed when the reservoir requires refilling (inhibited in flight)

PRESS – displays hydraulic pressure in pounds per square inch of the pump with the highest pressure.

Hydraulic Synoptic Display



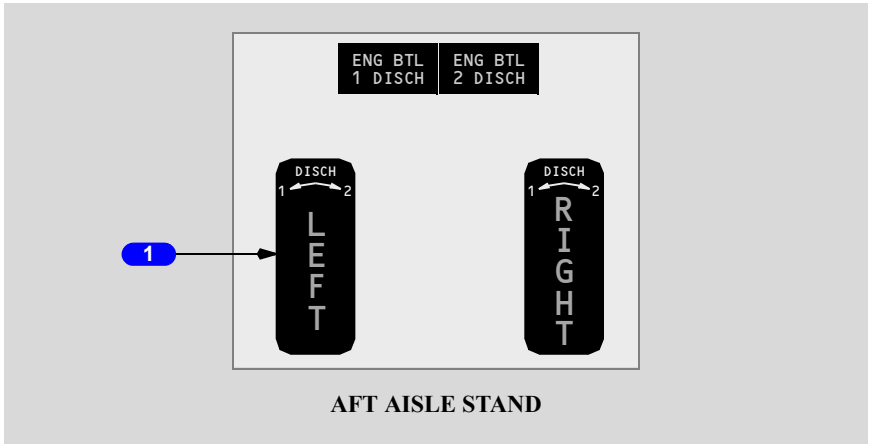
MULTIFUNCTION DISPLAY

AIR – air-driven pump
ELEC – electric-driven pump
ENG – engine-driven pump
ISLN – isolation valve
LO – reservoir quantity low
OF – reservoir quantity over-full
OVHT – pump overheat indication

RAT – ram air turbine pump
RF – reservoir requires refilling
SOV – shutoff valve
Closed valve – 
Failed pump – 

Miscellaneous Hydraulic System Controls

Engine Fire Panel



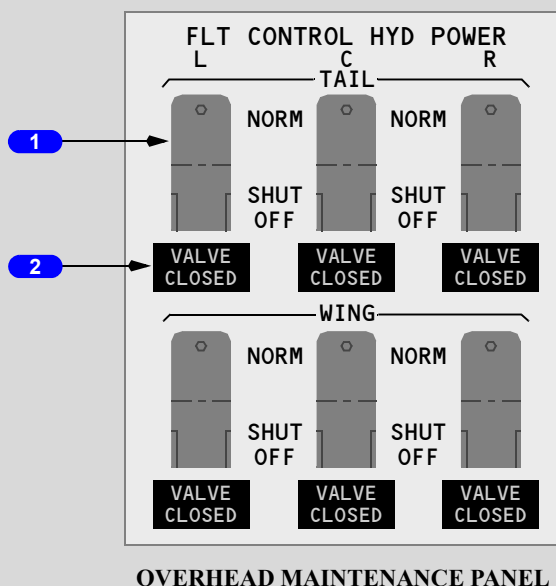
1 Engine Fire Switches

Pull –

- closes the engine–driven pump hydraulic supply shutoff valve
- depressurizes the engine–driven pump

Flight Control Hydraulic Power Switches

Note: No flight crew normal or non–normal procedures require operation of the flight control shutoff switches. These switches are for ground maintenance use only.



1 Flight Control Hydraulic Power Shutoff Switches

NORM – hydraulic system power is available to the flight control actuators.

SHUT OFF – hydraulic system power to the flight control actuators is shut off.

Note: In flight, the center system flight control shut off valves are isolated from electrical power and cannot be closed.

2 Flight Control Hydraulic Power VALVE CLOSED Lights

Illuminated (amber) – the related valve is closed.

Hydraulics

System Description

Chapter 13

Section 20

Introduction

The airplane has three independent hydraulic systems: left, right, and center. The hydraulic systems power the:

- flight controls
- leading edge slats
- trailing edge flaps
- landing gear
- wheel brakes
- nose and main gear steering
- thrust reversers

Flight control system components are distributed so that any one hydraulic system can provide adequate airplane controllability.

Hydraulic fluid is supplied to each hydraulic pump from the associated system reservoir. The reservoirs are pressurized by the bleed air system.

Left and Right Hydraulic Systems

The left and right hydraulic systems are identical. They differ only in the components they power.

The left hydraulic system powers:

- flight controls
- the left engine thrust reverser

The right hydraulic system powers:

- flight controls
- normal brakes
- the right thrust reverser

Left and Right Hydraulic System Primary Pumps

The left and right hydraulic systems each have a primary pump. The left and right primary pumps are engine-driven by the related left and right engines.

Left and Right Hydraulic System Demand Pumps

The left and right hydraulic systems each have a demand pump. The demand pumps are electric motor-driven. The demand pumps provide supplementary hydraulic power for periods of high system demand. The demand pumps also provide a backup hydraulic power source for the engine-driven primary pumps.

The pumps are controlled by the DEMAND L and R pump selectors. In the AUTO position, the L and R demand pumps operate for takeoff, landing, and when system or primary pump pressure is low. In the ON position, the demand pump runs continuously.

Center Hydraulic System

The center hydraulic system powers:

- flight controls
- leading edge slats
- trailing edge flaps
- landing gear actuation
- alternate brakes
- reserve brakes
- nose gear steering
- main gear steering

The ram air turbine (RAT) can provide hydraulic power to the center hydraulic system primary flight control components only.

Center Hydraulic System Primary Pumps

Two electric motor-driven primary pumps are the primary hydraulic power sources for the center hydraulic system. The PRIMARY C1 and C2 pump switches control pump operation.

On the ground:

With only a single ground power source, including the APU, the C2 pump will not run if the C1 pump is selected. The pump will not be load shed if one engine generator is operating, or the following sources are operating:

- primary external power and secondary external power
or
- APU generator and primary external power

In flight:

The C2 pump may be load shed by the electrical load management system when the following conditions exist:

- all other electric pumps are running
- there is a single source of electrical power
- generator capacity is exceeded

The pump will start automatically when the conditions that shed the pump no longer exist.

Center Hydraulic System Demand Pumps

The center hydraulic system has two air-driven demand pumps. The demand pumps provide supplementary hydraulic power for periods of high system demand. The demand pumps also provide a backup hydraulic power source for the center system electric motor-driven primary pumps.

The pumps are controlled by the DEMAND C1 and C2 pump selectors. In the AUTO position, a demand pump operates when system and/or primary pumps pressure is low, or when system logic anticipates a large demand. In the ON position, the demand pump runs continuously. Selecting both demand pumps ON results in only pump C1 operating. Both pumps cannot operate simultaneously when ON is selected for both pumps.

Center Hydraulic System Non–Normal Operation

If center hydraulic system quantity is sensed to be low and airspeed is greater than 60 knots the:

- reserve brakes are isolated from the center system and remain operable (the C1 pump and reserve fluid are dedicated to operating reserve brakes and nose gear steering)
- nose gear actuation and steering are isolated
- leading edge slats are isolated and not allowed to operate in the primary (hydraulic) mode

The leading edge slats are reconnected to the center hydraulic system and allowed to operate in primary mode when:

- center hydraulic fluid quantity recovers to normal for 5 seconds, and
- the system determines that both engines have been running for more than 30 seconds

Nose gear actuation and steering are reconnected when:

- airspeed decreases below 60 knots, or
- hydraulic pressure to the center system flight controls goes low, or
- the landing gear is selected down, both engines are normal, and both engine–driven pumps are providing pressure

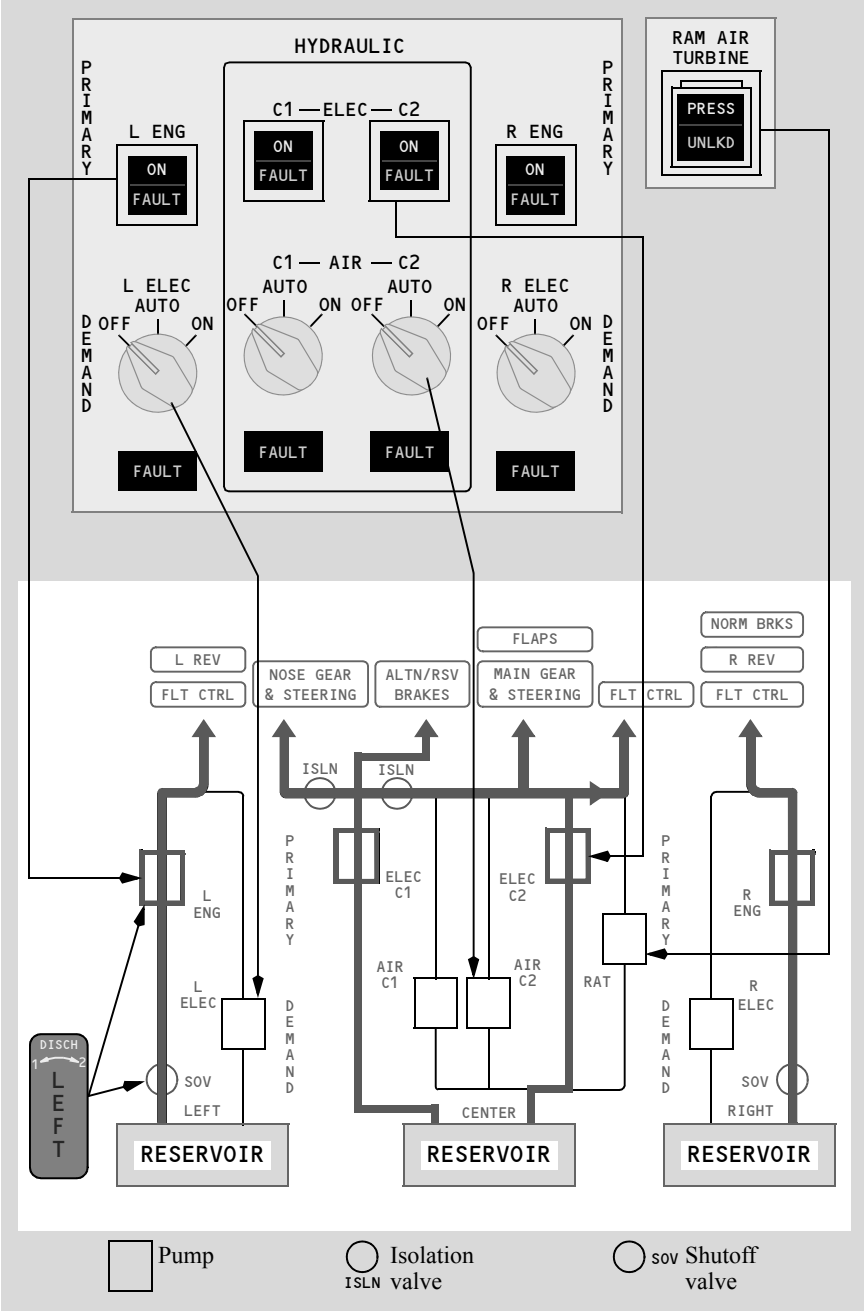
Ram Air Turbine (RAT)

The RAT, when deployed, provides hydraulic power only to the primary flight control components connected to the center hydraulic system. The RAT provides hydraulic and electrical power throughout the flight envelope. In flight, the RAT deploys automatically if:

- both engines are failed and center system pressure is low, or
- both AC transfer busses are unpowered, or
- all three hydraulic system pressures are low

The RAT can be deployed manually by pushing the RAM AIR TURBINE switch. The hot battery or APU battery bus must be powered. The center hydraulic system does not need to be powered. The RAT is deployed by a compressed spring. Once deployed, the RAT cannot be stowed in flight.

Hydraulic Systems Schematic



Hydraulics
EICAS Messages**Chapter 13**
Section 30**Hydraulics, Ram Air Turbine EICAS Messages**

The following EICAS messages can be displayed.

Message	Level	Aural	Message Logic
HYD AUTO CONTROL C	Advisory		Both center demand pump AUTO functions and all center hydraulic system indications are inoperative.
HYD AUTO CONTROL L, R	Advisory		Demand pump AUTO function and all left or right system indications are inoperative.
HYD OVERHEAT DEM C1, C2, L, R	Advisory		Demand pump temperature is high.
HYD OVERHEAT PRI C1, C2, L, R	Advisory		Primary pump temperature is high.
HYD PRESS DEM C1, C2, L, R	Advisory		Demand pump output pressure is low when commanded on.
HYD PRESS PRI C1, C2	Advisory		Primary pump output pressure is low.
HYD PRESS PRI L, R	Advisory		Primary pump output pressure is low.
HYD PRESS SYS C	Caution	Beeper	Center hydraulic system pressure is low.
HYD PRESS SYS L	Caution	Beeper	Left hydraulic system pressure is low.
HYD PRESS SYS L+C	Caution	Beeper	Left and center hydraulic system pressures are low.
HYD PRESS SYS L+R	Caution	Beeper	Left and right hydraulic system pressures are low.
HYD PRESS SYS L+C+R	Caution	Beeper	All hydraulic system pressures are low.
HYD PRESS SYS R	Caution	Beeper	Right hydraulic system pressure is low.
HYD PRESS SYS R+C	Caution	Beeper	Right and center hydraulic system pressures are low.
HYD QTY LOW C	Advisory		Center hydraulic system quantity is low.

Message	Level	Aural	Message Logic
HYD QTY LOW L, R	Advisory		Hydraulic quantity is low.

[AIMS BP2005]

HYD QTY LOW L+C	Caution	Beeper	Left and center hydraulic system quantities are low.
--------------------	---------	--------	--

[AIMS BP2005]

HYD QTY LOW L+C+R	Caution	Beeper	All three hydraulic system quantities are low.
----------------------	---------	--------	--

[AIMS BP2005]

HYD QTY LOW L+R	Caution	Beeper	Left and right system quantities are low.
--------------------	---------	--------	---

[AIMS BP2005]

HYD QTY LOW R+C	Caution	Beeper	Right and center system quantities are low.
--------------------	---------	--------	---

RAT UNLOCKED	Advisory		RAT is not stowed and locked.
--------------	----------	--	-------------------------------

Landing Gear**Chapter 14****Table of Contents****Section 0**

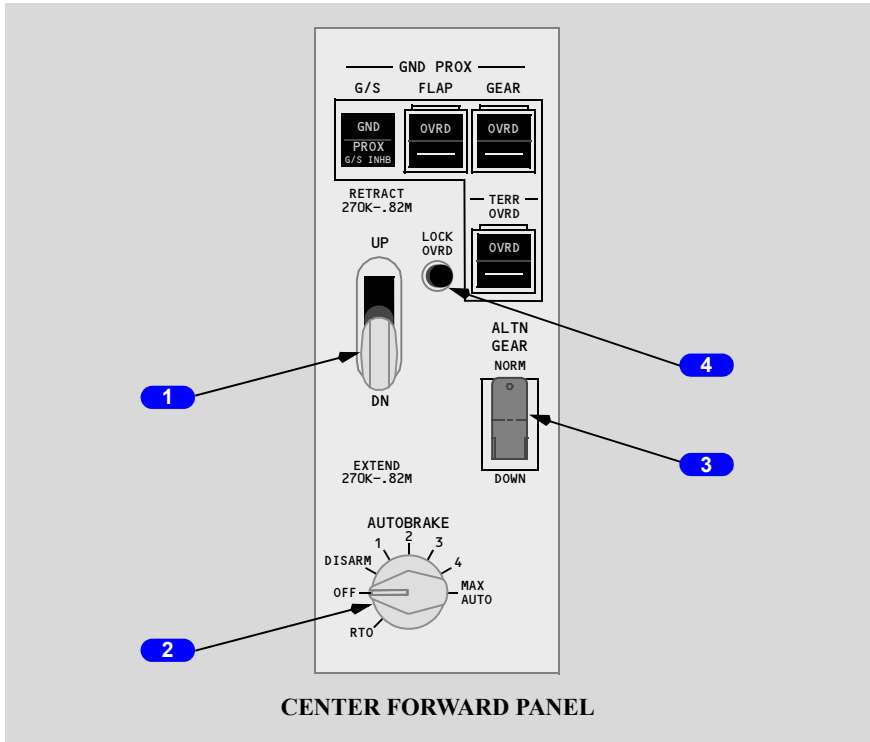
Controls and Indicators	14.10
Landing Gear Panel	14.10.1
Nose Wheel Steering Tiller	14.10.2
Brake System	14.10.3
Rudder/Brake Pedals	14.10.3
Parking Brake Lever	14.10.3
Brake Accumulator Pressure Indicator	14.10.4
Landing Gear System Indications	14.10.5
Landing Gear Position Indications	14.10.5
Gear Synoptic Display	14.10.6
System Description	14.20
Introduction	14.20.1
Air/Ground Sensing System	14.20.1
Landing Gear Operation	14.20.1
Landing Gear Retraction	14.20.2
Landing Gear Extension	14.20.2
Landing Gear Alternate Extension	14.20.3
Semi-Levered Gear	14.20.3
Nose Wheel and Main Gear Aft Axle Steering	14.20.3
Brake System	14.20.4
Normal Brake Hydraulic System	14.20.4
Alternate Brake Hydraulic System	14.20.4
Brake Accumulator	14.20.4
Antiskid Protection	14.20.4
Autobrake System	14.20.5
Parking Brake	14.20.7
Brake Temperature Indication	14.20.7
Tire Pressure Indication	14.20.7
Tail Skid	14.20.8

EICAS Messages	14.30
Landing Gear EICAS Messages	14.30.1

Landing Gear Controls and Indicators

Chapter 14 Section 10

Landing Gear Panel



1 Landing Gear Lever

UP – the landing gear retracts.

DN – the landing gear extends.

2 AUTOBRAKE Selector

OFF – deactivates and resets the autobrake system.

DISARM –

- disengages the autobrake system
- releases brake pressure.

1, 2, 3, 4, MAX AUTO – selects the desired deceleration rate.

RTO – automatically applies maximum brake pressure when the thrust levers are retarded to idle above 85 knots.

3 Alternate Gear (ALTN GEAR) Switch

NORM – the landing gear lever operates normally.

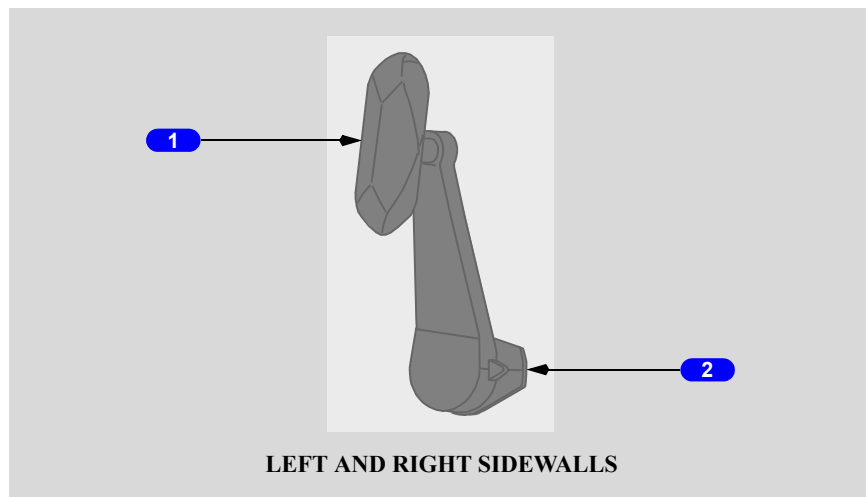
DOWN – the landing gear extends by the alternate extension system.

Note: Alternate extension may be selected with the landing gear lever in any position.

4 Landing Gear Lever Lock Override (LOCK OVRD) Switch

Push – releases the landing gear lever lock.

Nose Wheel Steering Tiller



1 Nose Wheel Steering Tiller

Rotate –

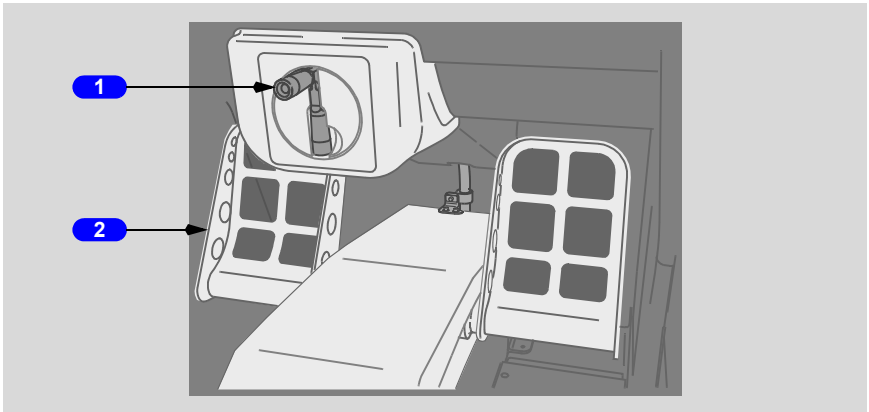
- turns the nose wheels up to 70 degrees in either direction
- overrides rudder pedal steering
- main gear aft axle steering is slaved to nose wheel steering.

2 Tiller Position Indicator

Shows tiller displacement from the straight-ahead, neutral position.

Brake System

Rudder/Brake Pedals



1 Rudder Pedal Adjust Crank

Adjusts the rudder pedals forward or aft.

Note: To avoid inadvertent rudder pedal movement, the crank handle should be stowed when not in use.

2 Rudder/Brake Pedals

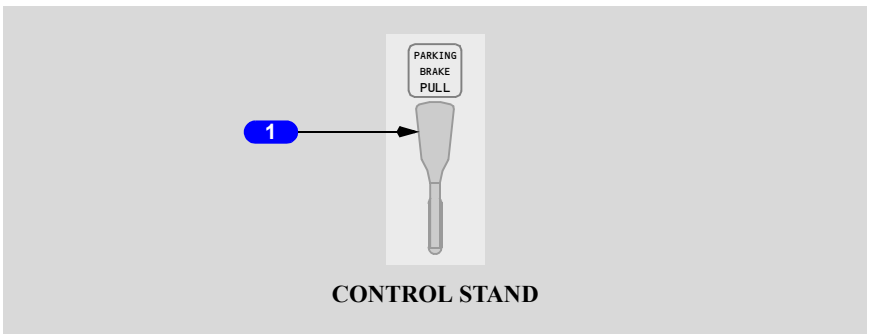
Push the full pedal –

- turns the nose wheel up to 7 degrees in either direction
- does not activate main gear steering.

Push the top of the pedals – actuates the wheel brakes.

Refer to Chapter 9, Flight Controls for the description of rudder operation.

Parking Brake Lever

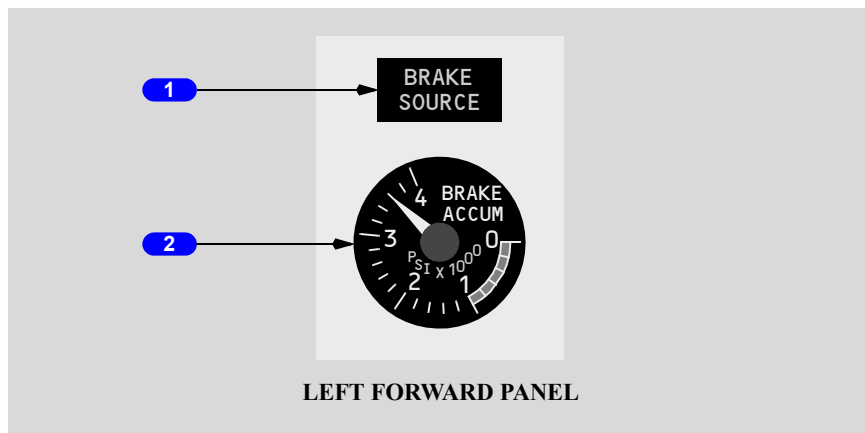


1 Parking Brake Lever

Pull – sets the parking brake when both brake pedals are simultaneously depressed.

Release – simultaneously depress both brake pedals.

Brake Accumulator Pressure Indicator



1 BRAKE SOURCE Light

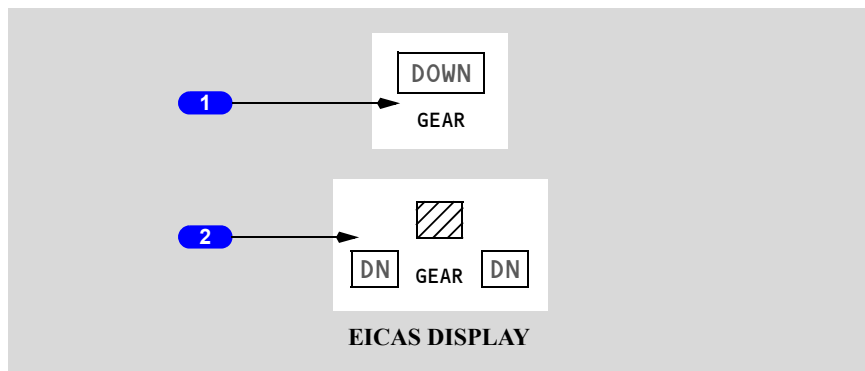
Illuminated (amber) – both active brake hydraulic sources (right and center/reserve hydraulic systems) have low pressure.

2 BRAKE ACCUMULATOR PRESSURE Indicator

Indicates brake accumulator pressure.

Landing Gear System Indications

Landing Gear Position Indications



1 Gear Position Indication (Normal Display)

DOWN (green) – all landing gear are down and locked.

Crosshatched (white) – one or more landing gear are in transit.

UP (white) – all landing gear are up and locked (blanks after 10 seconds).

Empty box (white) – all landing gear position indicators are inoperative.

2 Expanded Gear Position Indication (Non-Normal Display)

DN (green) – the associated landing gear is down and locked.

Crosshatched (white) – the associated landing gear is in transit.

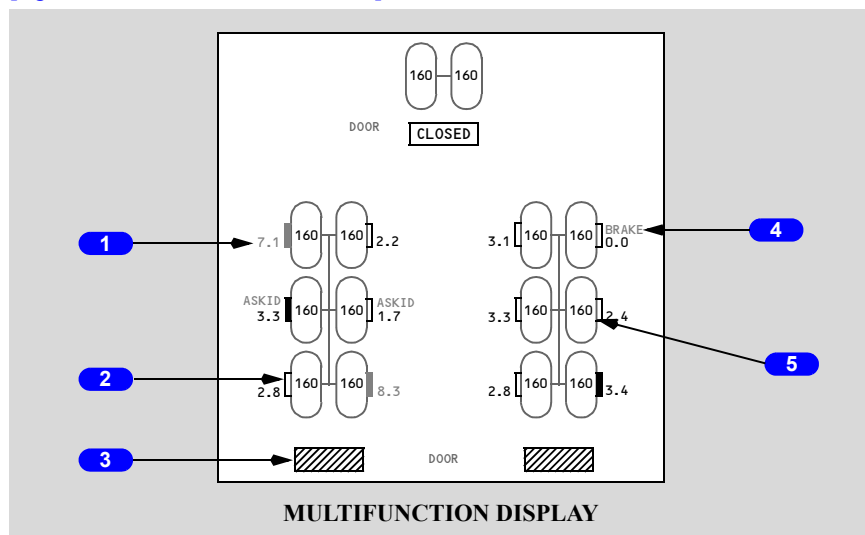
UP (white) – the associated landing gear is up and locked.

Empty box(es) (white) – the associated landing gear position indicators are inoperative.

Gear Synoptic Display

The landing gear synoptic is displayed by pushing the GEAR synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

[Option – Tire Pressure Indication]



1 Brake Temperature

Indicates a relative value of wheel brake temperature:

- values range from 0.0 to 9.9
- white – normal range
- amber – high range.

2 Brake Symbol

Blank box indicates any brake less than 3.0.

Solid white box indicates hottest brake on each main gear within range of 3.0 to 4.9.

Solid amber box indicates brake overheat condition on each wheel within range of 5.0 to 9.9.

3 Gear Door Status

Crosshatched – the door is not closed.

CLOSED (white) – the door is closed.

Empty box(es) (white) – the associated landing gear door position indicators are inoperative.

4 Fault Indication (amber)

BRAKE – indicates brake deactivation on the associated wheel.

ASKID – indicates antiskid fault on the associated wheel.

5 Tire Pressure Indication

Displays individual tire pressures:

- white – normal range
- amber – abnormal high or low range.

Intentionally
Blank

Landing Gear System Description

Chapter 14 Section 20

Introduction

The airplane has two main landing gear and a single nose gear. The nose gear is a conventional steerable two-wheel unit. Each main gear has six wheels in tandem pairs. To improve turning radius, the aft axle of each main gear is steerable.

Hydraulic power for retraction, extension, and steering is supplied by the center hydraulic system. An alternate extension system is also provided.

[Option – Synoptic Tire Pressure Indication]

The normal brake hydraulic system is powered by the right hydraulic system. The alternate brake hydraulic system is powered by the center/reserve hydraulic system. Antiskid protection is provided with both systems, but the autobrake system is available only through the normal system. A brake temperature monitor system and tire pressure indication system displays each brake temperature and tire pressure on the GEAR synoptic display.

Air/Ground Sensing System

In-flight and ground operation of various airplane systems are controlled by the air/ground sensing system.

The system receives air/ground logic signals from sensors located on each main landing gear beam. These signals are used to configure the airplane systems to the appropriate air or ground status.

Landing Gear Operation

The landing gear are normally controlled by the landing gear lever. On the ground, the lever is held in the DN position by an automatic lever lock. The lever lock can be manually overridden by pushing and holding the landing gear lever LOCK OVERRIDE switch. In flight, the lever lock is automatically released through air/ground sensing.

Landing Gear Retraction

When the landing gear lever is moved to UP, the landing gear begins to retract. The landing gear doors open and the main gear wheels tilt to the retract position. The EICAS landing gear position indication display changes from a green DOWN indication to a white crosshatch in-transit indication as the landing gear retract into the wheel wells. After retraction, the landing gear are held up by uplocks. The EICAS landing gear position indication changes to UP for 10 seconds and then blanks. With the landing gear retracted and all doors closed, the landing gear hydraulic system is automatically depressurized.

If any gear is not up and locked up after the normal transit time, the EICAS caution message GEAR DISAGREE is displayed. The EICAS gear position indication changes to the expanded non-normal format, with the affected gear displayed as in-transit or down, if the gear never unlocked from the down position. The EICAS advisory message GEAR DOOR is displayed if any hydraulically actuated door is not closed after normal transit time.

Landing Gear Extension

When the landing gear lever is moved to DN, the landing gear doors open, the gear are unlocked, and the in-transit indication is displayed on the EICAS landing gear position indication.

The gear free-fall without hydraulic power to the down and locked position. The downlocks are powered to the locked position, all hydraulically actuated gear doors close, and the main gear trucks hydraulically tilt to the flight position. When all gear are down and locked, the EICAS gear position indication displays DOWN.

The EICAS caution message GEAR DISAGREE is displayed if any gear is not locked down (side and drag brace on the same main gear not locked, or nose gear drag brace not locked) after the normal transit time. The EICAS gear position indication changes to the expanded non-normal format, with the affected gear displayed as in transit (or UP if the gear never unlocked from the up position).

If only one brace on a main gear is locked (either drag or side brace not locked) after the normal transit time, the EICAS caution message MAIN GEAR BRACE L or R is displayed for the affected gear. The EICAS gear position indication changes to the expanded non-normal format, with the affected gear displayed as in transit. The EICAS advisory message GEAR DOOR displays if any hydraulically actuated door is not closed after the normal transit time.

Landing Gear Alternate Extension

The alternate landing gear extension system uses a dedicated DC powered electric hydraulic pump and center hydraulic system fluid to extend the landing gear. Selecting DOWN on the ALTERNATE GEAR switch releases all door and gear uplocks. The landing gear free-fall to the down and locked position. The landing gear lever position has no effect on landing gear alternate extension.

The EICAS landing gear position indication displays the expanded gear position indication when the alternate extension system is used. During alternate extension, the EICAS message GEAR DOOR is displayed because all the hydraulically powered gear doors remain open.

Following an alternate extension, the landing gear can be retracted by the normal system, if it is operating. Select DN then UP to retract the landing gear using the normal system.

Semi-Levered Gear

[777-300ER]

The semi-levered gear consists of an additional hydraulic actuator that connects the forward end of each main gear truck to the shock strut. During takeoff, the actuator locks to restrict rotation of the main gear truck and allow takeoff rotation about the aft wheel axle, thereby improving airplane performance capability. During landing, the actuator is unlocked to permit rotation of the main gear truck and provide additional damping.

Nose Wheel and Main Gear Aft Axle Steering

The airplane is equipped with nose wheel steering and main gear aft axle steering. Nose wheel steering is powered by the center/reserve hydraulic system. Main gear aft axle steering is powered by the center hydraulic system.

Primary steering control is provided by a nose wheel steering tiller for each pilot. Limited steering control is available through the rudder pedals. The tillers can turn the nose wheels up to 70 degrees in either direction. A pointer on the tiller assembly shows tiller position relative to the neutral setting. The rudder pedals can be used to turn the nose wheels up to 7 degrees in either direction. Tiller inputs override rudder pedal inputs.

Main gear aft axle steering automatically operates when the nose wheel steering angle exceeds 13 degrees to reduce tire scrubbing.

The EICAS warning message CONFIG GEAR STEERING, accompanied by the takeoff configuration aural alert, is displayed if the main gear aft axles are not centered and locked when takeoff thrust is applied. The EICAS advisory message MAIN GEAR STEERING is displayed if the main gear steering actuators are not locked in the centered position when commanded to the center position.

Brake System

Each main gear wheel has a multiple disc carbon brake. The nose wheels have no brakes. The brake system includes:

- normal brake hydraulic system
- alternate brake hydraulic system
- brake accumulator
- antiskid protection
- autobrake system
- parking brake.

Normal Brake Hydraulic System

The normal brake hydraulic system is powered by the right hydraulic system. The brake pedals provide independent control of the left and right brakes.

Alternate Brake Hydraulic System

Alternate brake hydraulic system selection is automatic. If the right hydraulic system pressure is low, the center/reserve hydraulic system automatically supplies pressure to the alternate brake hydraulic system. Pushing a brake pedal then sends hydraulic pressure through the alternate antiskid valves to the brakes. If center hydraulic system fluid quantity is low, the C1 primary pump is isolated from the center hydraulic system to provide a reserve braking pressure source.

Loss of the right and center/reserve hydraulic systems causes the BRAKE SOURCE light to illuminate and the EICAS advisory message BRAKE SOURCE to display.

Brake Accumulator

The brake accumulator is located in the normal brake hydraulic system. If right and center/reserve brake hydraulic power is lost, the brake accumulator can provide several braking applications or parking brake application.

Antiskid Protection

Antiskid protection is provided in the normal and alternate brake hydraulic systems. Antiskid protection is also provided when the brake system is being supplied pressure only from the brake accumulator.

The normal brake hydraulic system provides each main gear wheel with individual antiskid protection. When a wheel speed sensor detects a skid, the associated antiskid valve reduces brake pressure until skidding stops.

The alternate brake hydraulic system provides antiskid protection to tandem wheel pairs for the forward and middle axle wheels. The aft axle wheels remain individually controlled.

Touchdown and hydroplaning protection is provided using airplane inertial ground speed. Locked wheel protection is provided using a comparison with other wheel speeds.

The EICAS advisory message ANTISKID is displayed if an antiskid fault affecting the brake hydraulic system in use is detected, or if the parking brake valve is not fully open with the parking brake released, or if the system is completely inoperative.

Autobrake System

The autobrake system provides automatic braking at preselected deceleration rates for landing and full pressure for rejected takeoff. The system operates only when the normal brake system is functioning. Antiskid system protection is provided during autobrake operation.

EICAS memo messages display the selected autobrake settings:

- AUTOBRAKE 1 through 4
- AUTOBRAKE MAX
- AUTOBRAKE RTO.

The EICAS advisory message AUTOBRAKE is displayed if the autobrake system is disarmed or inoperative, or autobrake solenoid valve pressure is high when not commanded on.

Rejected Takeoff

Selecting RTO (rejected takeoff) prior to takeoff arms the autobrake system. The RTO mode can be selected only on the ground. The RTO autobrake setting commands maximum braking pressure if:

- the airplane is on the ground
- groundspeed is above 85 knots, and
- both thrust levers are retarded to idle.

Maximum braking is obtained in this mode. If an RTO is initiated below 85 knots, the RTO autobrake function does not operate.

Taxi Brake Release

During each taxi brake application, the antiskid system releases the brakes of one axle pair of each main landing gear (if wheel speeds are less than 45 knots). The system sequences through the axle pairs at each brake application, thereby reducing the number of brake applications by each brake. This extends service life and reduces brake sensitivity during taxi.

All active brakes are applied for a heavy brake application, landing rollout, RTO, or when setting the parking brake.

The taxi brake release system operates only with the normal brake hydraulic system.

Landing

Five levels of deceleration can be selected for landing. However, on dry runways, the maximum autobrake deceleration rate in the landing mode is less than that produced by full pedal braking.

After landing, autobrake application begins when:

- both thrust levers are retarded to idle, and
- the wheels have spun up.

Autobrake application occurs slightly after main gear touchdown. If MAX AUTO is selected, deceleration is limited to the AUTOBRAKE 4 level until pitch angle is less than one degree, then deceleration is increased to the MAX AUTO level. The deceleration level can be changed (without disarming the system) by rotating the selector.

To maintain the selected airplane deceleration rate, autobrake pressure is reduced as other controls, such as thrust reversers and spoilers, contribute to total deceleration. The system provides braking to a complete stop or until it is disarmed.

Autobrake – Disarm

The autobrake system disarms and the EICAS advisory message AUTOBRAKE is displayed if any of the following occur:

- pedal braking applied
- either thrust lever advanced after landing
- speedbrake lever is moved to the DOWN detent after the speedbrakes have deployed on the ground
- DISARM or OFF position selected on the AUTOBRAKE selector
- autobrake fault
- normal antiskid system fault
- loss of inertial data from the ADIRU
- the autobrake is applied after loss of normal brake hydraulic pressure.

When the autobrake system disarms after landing, the AUTOBRAKE selector automatically moves to the DISARM position, and removes power from the autobrake system.

When the autobrake system disarms during takeoff, the AUTOBRAKE selector remains in the RTO position, but automatically moves to OFF after takeoff.

Parking Brake

The parking brake can be set with the normal or alternate brake hydraulic system pressurized. If the normal and alternate brake systems are not pressurized, parking brake pressure is maintained by the brake accumulator. The brake accumulator is pressurized by the right hydraulic system. Accumulator pressure is shown on the BRAKE ACCUMULATOR PRESSURE indicator.

The parking brake is set by fully depressing both brake pedals, pulling the parking brake lever up, then releasing the pedals. This mechanically latches the pedals in the depressed position and commands the parking brake valve to close.

The parking brake is released by depressing the pedals until the parking brake lever releases.

When the parking brake is set, the EICAS memo message PARKING BRAKE SET is displayed. If the parking brake is set and either engine is set to takeoff thrust, the takeoff configuration aural alert sounds and the EICAS warning message CONFIG PARKING BRAKE is displayed.

Brake Temperature Indication

Wheel brake temperatures are displayed on the GEAR synoptic display. Numerical values related to wheel brake temperature are displayed adjacent to each wheel/brake symbol. These values range from 0.0 to 9.9 in increments of 0.1. The values tend to increase after the brakes are used.

Normal range values of 0 to 4.9 are white. For values of 3.0 to 4.9, the brake symbol for the hottest brake becomes solid white. Values of 5.0 and above are amber. For values of 5.0 and above, the EICAS advisory message BRAKE TEMP is displayed.

Tire Pressure Indication

[Option]

Individual tire pressures, from 0 to 400 PSI, are displayed inside the individual wheel symbols on the GEAR synoptic display.

The EICAS advisory message TIRE PRESS is displayed if any tire pressure is above or below the normal range, or there is an excessive pressure difference between two tires on the same axle.

Tail Skid

[777-300 and 777-300ER]

The airplane is equipped with a tail skid system. The tail skid extends for takeoff and landing and retracts during flight. It helps protect the pressurized part of the airplane from contact with the runway. The tail skid uses the main landing gear actuation system.

The EICAS advisory message TAIL SKID is displayed when the tail skid is not in the correct position.

**Landing Gear
EICAS Messages****Chapter 14
Section 30****Landing Gear EICAS Messages**

The following EICAS messages can be displayed.

Note: Configuration warning messages are covered in Chapter 15, Warning Systems.

Brakes

Message	Level	Aural	Message Logic
ANTISKID	Advisory		A fault is detected in the antiskid system.
AUTOBRAKE	Advisory		Autobrake is disarmed or inoperative.
AUTOBRAKE 1, 2, 3, 4, MAX, RTO	Memo		Indicates selected autobrake level.
BRAKE SOURCE	Advisory		Normal, alternate, and reserve brakes are not available.
BRAKE TEMP	Advisory		Temperature of one or more brakes is excessive.
PARKING BRAKE SET	Memo		The parking brake lever is up and the parking brake valve is closed
RESERVE BRAKES/STRG	Advisory		Reserve brakes, normal nose gear extension, and nose wheel steering may not be available.

Landing Gear

Message	Level	Aural	Message Logic
GEAR DISAGREE	Caution	Beeper	Gear position disagrees with landing gear lever position.
GEAR DOOR	Advisory		One or more gear doors are not closed.
MAIN GEAR BRACE L, R	Caution	Beeper	Affected main gear is down with one brace unlocked.
MAIN GEAR STEERING	Advisory		Main gear steering is unlocked when centered.

Tail Skid

[777-300 and 777-300ER]

Message	Level	Aural	Message Logic
TAIL SKID	Advisory		Tail skid position disagrees with landing gear lever position.

Tires

[Option]

Message	Level	Aural	Message Logic
TIRE PRESS	Advisory		One or more tire pressures are not normal.

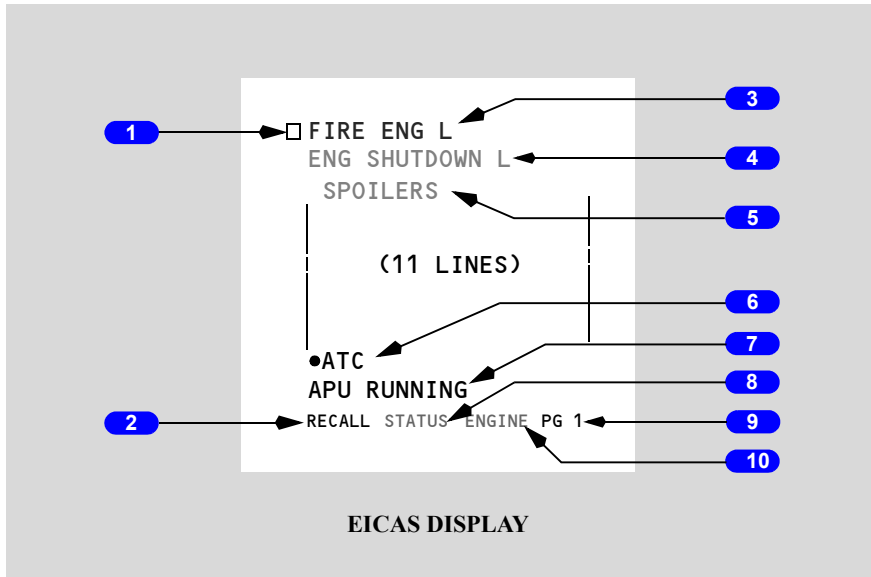
Warning Systems**Chapter 15****Table of Contents****Section 0**

Controls and Indicators	15.10
Engine Indication and Crew Alerting System (EICAS)	15.10.1
EICAS Messages	15.10.1
Display Select Panel	15.10.3
Engine Fail, GPWS, and PWS Alerts on PFD	15.10.4
Master WARNING/CAUTION Reset Switches and Lights	15.10.5
Traffic Alert and Collision Avoidance System (TCAS)	15.10.6
TCAS Controls (Transponder Panel)	15.10.6
TCAS Controls (EFIS Control Panel)	15.10.9
TCAS Traffic and TCAS Alert Message TRAFFIC Display	15.10.10
TCAS PFD Vertical Guidance	15.10.12
Ground Proximity Warning System (GPWS) Controls	15.10.14
RAAS Runway Override Control	15.10.14
Ground Proximity Panel	15.10.14
Radio Altitude/Barometric Altitude Control	15.10.17
GPWS Look-Ahead Terrain Alerting Display and Annunciations	15.10.18
Predictive Windshear (PWS) Display and Annunciations	15.10.21
Status Display	15.10.22
EICAS Event Record Switch	15.10.23
System Description	15.20
Introduction	15.20.1
Engine Indication and Crew Alerting System (EICAS)	15.20.1
System Alert Level Definitions	15.20.1
EICAS Messages	15.20.2
Aurals, Master WARNING/CAUTION Switches and Lights, and GND PROX Light	15.20.4
Flight Deck Panel Annunciator Lights	15.20.9
Airspeed Voice Annunciations and Alerts	15.20.9
Takeoff V1 Airspeed	15.20.9

Stall Warning	15.20.9
Airspeed Low	15.20.9
Overspeed Warning	15.20.9
Tail Strike Detection System	15.20.10
Takeoff And Landing Configuration Warning System	15.20.10
Takeoff Configuration Warnings	15.20.10
Landing Configuration Warning	15.20.10
Speedbrake Lever Extend Beyond ARM During Climb. . .	15.20.11
Configuration Warning System Non-normal Operation. . .	15.20.11
MCP Selected Altitude Alert	15.20.11
Approaching MCP Selected Altitude	15.20.11
Departing MCP Selected Altitude.	15.20.12
MCP Selected Altitude Alert Inhibits	15.20.12
Crew Alertness Monitor	15.20.12
Traffic Alert and Collision Avoidance System (TCAS)	15.20.12
Resolution Advisories (RA) and Display	15.20.13
Traffic Advisories (TA) and Display	15.20.13
Proximate Traffic Display	15.20.14
Other Traffic Display	15.20.14
TCAS PFD Vertical Guidance	15.20.15
TCAS ND Messages	15.20.15
TCAS Voice Annunciations	15.20.16
TCAS Normal Operation	15.20.18
TCAS Non-Normal Operation	15.20.18
Ground Proximity Warning System (GPWS)	15.20.19
Introduction	15.20.19
Runway Awareness and Advisory System (RAAS)	15.20.19
Look-ahead Obstacles and Peaks Terrain Alerting System .	15.20.22
Predictive Wind Shear (PWS) and Immediate Windshear Alerting Systems	15.20.24
Bank Angle Voice Annunciations	15.20.27
Immediate Alerting System	15.20.27
Altitude Voice Annunciations During Approach	15.20.28
GPWS Non-Normal Operation	15.20.29

Alert Inhibits	15.20.30
Alert Messages Inhibited During Normal System Operation	15.20.30
Alert Messages Inhibited By Other Alert Messages	15.20.30
Voice Annunciation Inhibits.	15.20.30
ND Display Alert Inhibits and Automatic Display	15.20.30
Alerts Inhibited Before Engine Start and After Shutdown. .	15.20.32
Alerts Inhibited During Engine Start	15.20.33
Alerts Inhibited During Takeoff.	15.20.33
Alerts Inhibited During Landing	15.20.37
EICAS Event Record.	15.20.38
EICAS Messages.	15.30
Warning Systems EICAS Alert Messages.	15.30.1

Intentionally
Blank

**Warning Systems
Controls and Indicators****Chapter 15
Section 10****Engine Indication and Crew Alerting System (EICAS)****EICAS Messages****1 Checklist Icon**

Displayed (white) –

- when checklist with procedural steps, notes, or other information of which the crew must be made aware exists for respective message
- no longer displayed when checklist complete
- no longer displayed when inhibited by checklist of another message

2 RECALL Indication

Displayed (white) –

- when CANCEL/RECALL switch pushed
- remains displayed for one second after switch released

3 Warning Messages

Displayed (red) –

- highest priority alert messages
- red alert messages remain displayed and cannot be canceled by pushing the CANC/RCL switch.

4 Caution Messages

Displayed (amber) –

- next highest priority alert messages after warning messages
- amber alert messages can be canceled or recalled by pushing the CANC/RCL switch

5 Advisory Messages

Displayed (amber) –

- lowest priority alert messages; indented one space
- amber alert messages can be canceled or recalled by pushing the CANC/RCL switch

6 Communication Messages

Displayed (white) –

- prefaced with white dot
- COMM low messages indented one space
- cannot be canceled by pushing the CANC/RCL switch

7 Memo Messages

Displayed (white) –

- reminder of selected state of controls or systems
- cannot be canceled by pushing the CANC/RCL switch
- EICAS alert messages have display priority over memo messages; some or all memo messages not displayed on current EICAS message page if insufficient message lines are available below alert messages

8 STATUS Cue

Displayed (cyan) –

- new status message exists
- no longer displayed when status display selected
- inhibited from beginning of first engine start until 30 minutes after lift-off

9 Page (PG) Number

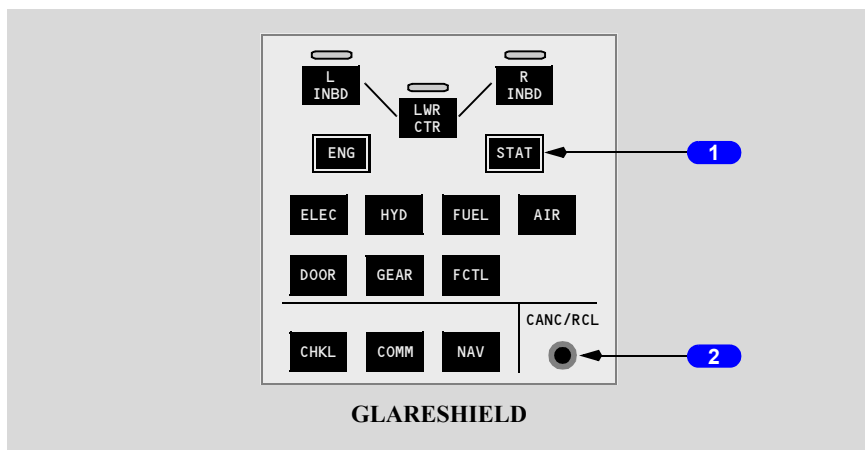
Displayed (white) –

- more than one page of alert or memo messages exists
- indicates number of page selected

10 ENGINE Excedence Cue

Displayed (cyan) –

- engine parameter on secondary engine display is exceeded
- displayed until displayed parameter returns to normal operating range

Display Select Panel**1 Status (STAT) Display Switch**

Push – displays status display on selected MFD.

Subsequent pushes –

- displays next page of status messages when additional pages exist
- lower center MFD blanks when last page of status messages displayed
- inboard MFDs return to NAV display after last page of status messages displayed

2 Cancel/Recall (CANC/RCL) Switch

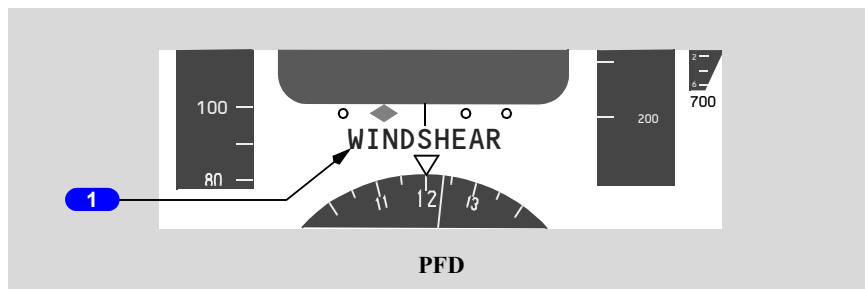
Push (when EICAS caution or advisory messages displayed) –

- displays the next page of EICAS messages when additional pages exist
- cancels caution and advisory messages when last page displayed; warning, memo, and communications messages remain displayed
- cancels red box for any engine parameter previously exceeded when displayed parameter no longer exceeds the limit

Push (when no EICAS caution or advisory messages displayed) –

- redisplay all caution and advisory EICAS messages, when non-normal condition exists
- displays first page of messages when multiple pages exist
- redisplay red box for parameters previously exceeded

Engine Fail, GPWS, and PWS Alerts on PFD



1 Alert on PFD

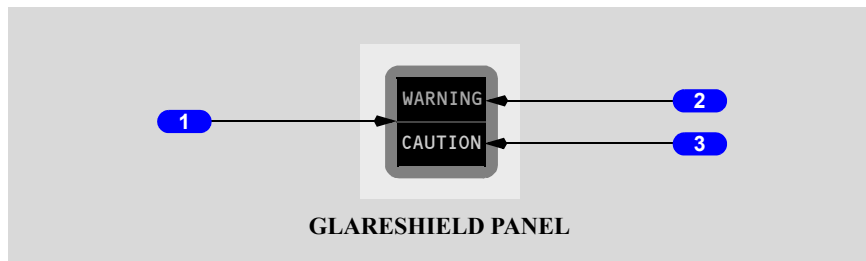
ENG FAIL (red) – ENGINE FAIL alert is occurring.

PULL UP (red) – PULL UP alert is occurring.

WINDSHEAR (red) –

- predictive WINDSHEAR AHEAD alert or immediate WINDSHEAR alert is occurring
- all other GPWS alerts inhibited

Master WARNING/CAUTION Reset Switches and Lights

**1 Master WARNING/CAUTION Reset Switch**

Push –

- extinguishes master WARNING lights
- extinguishes master CAUTION lights
- silences the aural that accompanies the EICAS warning messages:
 - CABIN ALTITUDE
 - CONFIG GEAR, if displayed because landing gear not down and locked, any thrust lever at idle, and radio altitude less than 800 feet
 - FIRE
 - PILOT RESPONSE

2 Master WARNING Light

Illuminated (red) –

- new EICAS warning message displayed, or
- ENGINE FAIL, PULL UP, or WINDSHEAR alert displayed on PFD

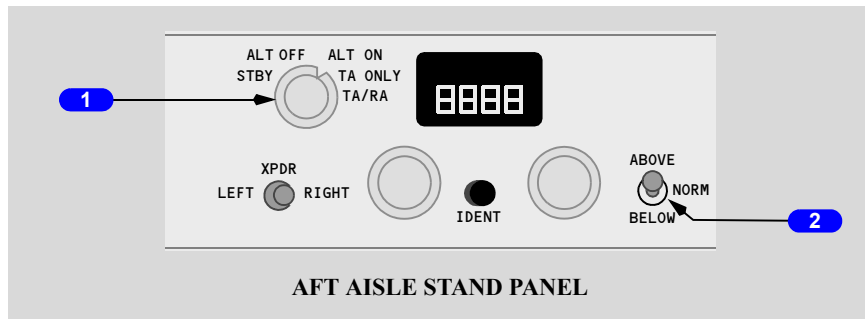
3 Master CAUTION Light

Illuminated (amber) – new EICAS caution message displayed

Traffic Alert and Collision Avoidance System (TCAS)

TCAS Controls (Transponder Panel)

[Options – Bendix 071-01503-2901]



1 Transponder Mode Selector

TA ONLY (traffic advisory) –

- transponder and TCAS TA modes enabled
- all aircraft that would have been predicted as a RA are predicted as a TA

TA/RA (traffic advisory/resolution advisory) – transponder and TCAS TA and RA modes enable.

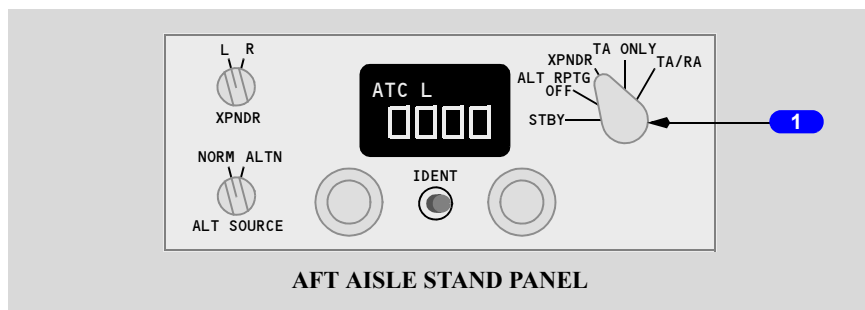
2 TCAS Airspace Switch

ABOVE – altitude reporting traffic from 2,700 feet below to 9,000 feet above current altitude displayed.

NORM (normal) – altitude reporting traffic from 2,700 feet below to 2,700 feet above current altitude displayed.

BELOW – altitude reporting traffic 9,000 feet below to 2,700 feet above current altitude displayed.

[Options – Gables G7131-01, -02]



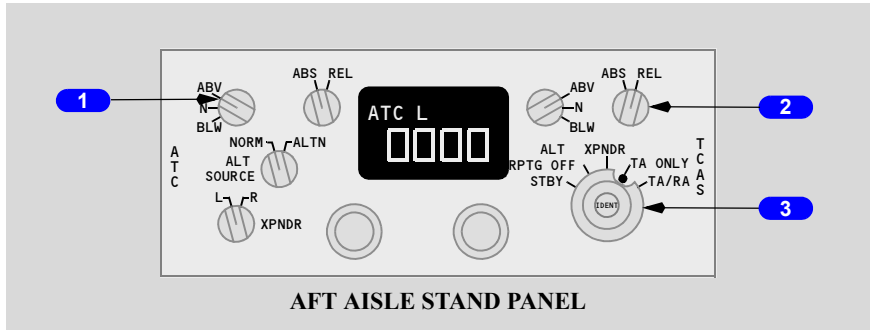
1 Transponder Mode Selector

TA ONLY (traffic advisory) –

- transponder and TCAS TA modes enabled
- all aircraft that would have been predicted as a RA are predicted as a TA

TA/RA (traffic advisory/resolution advisory) – transponder and TCAS TA and RA modes enable.

[Options – Gables G7131–03 & –04]

**1 TCAS Airspace Selector**

Left switch controls Captain TCAS display. Right switch controls First Officer TCAS display.

ABV (above) – altitude reporting traffic from 2,700 feet below to 7,000 feet above current altitude displayed.

N (normal) – altitude reporting traffic from 2,700 feet below to 2,700 feet above current altitude displayed.

BLW (below) – altitude reporting traffic 7,000 feet below to 2,700 feet above current altitude displayed.

2 TCAS Absolute/Relative (ABS/REL) Altitude Selector

Left switch controls Captain TCAS display. Right switch controls First Officer TCAS display.

ABS (absolute) – absolute altitude displayed in TCAS traffic symbol data tags.

REL (relative) – relative altitude displayed in TCAS traffic symbol data tags.

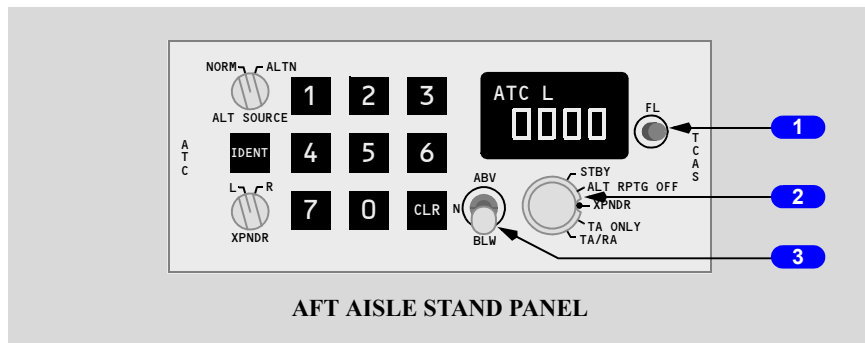
3 Transponder Mode Selector

TA ONLY (traffic advisory) –

- transponder and TCAS TA modes enabled
- all aircraft that would have been predicted as a RA are predicted as a TA

TA/RA (traffic advisory/resolution advisory) – transponder and TCAS TA and RA modes enable.

[Option – Gables G7156-01]



1 TCAS Flight Level (FL) Switch

Push and hold – absolute altitude displayed in TCAS traffic symbol data tags on both NDs.

2 Transponder Mode Selector

TA ONLY (traffic advisory) –

- transponder and TCAS TA modes enabled
- all aircraft that would have been predicted as a RA are predicted as a TA

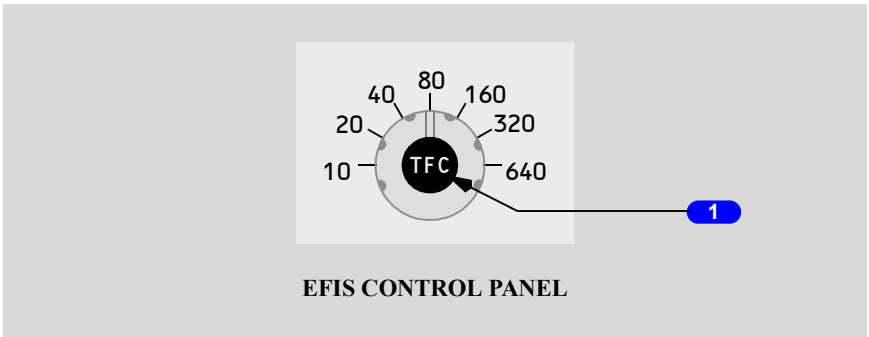
TA/RA (traffic advisory/resolution advisory) – transponder and TCAS TA and RA modes enable.

3 TCAS Airspace Switch

ABV (above) – altitude reporting traffic from 2,700 feet below to 7,000 feet above current altitude displayed.

N (normal) – altitude reporting traffic from 2,700 feet below to 2,700 feet above current altitude displayed.

BLW (below) – altitude reporting traffic 7,000 feet below to 2,700 feet above current altitude displayed.

TCAS Controls (EFIS Control Panel)**1 ND Traffic (TFC) Switch (inner)**

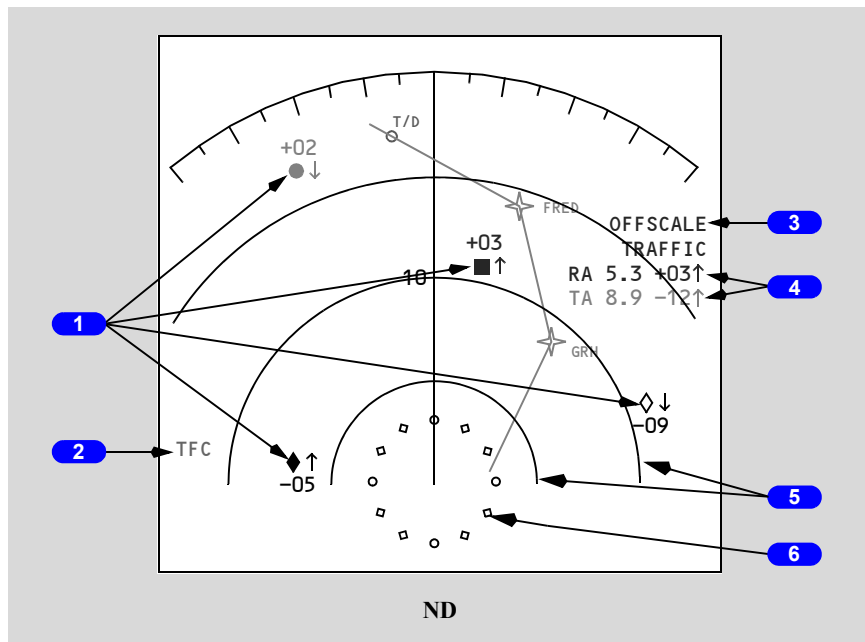
Push –

- TCAS traffic displayed on ND
- range information displayed when in the expanded APP or VOR modes

Displayed when TFC selected and respective ND is in MAP, MAP CTR, VOR, or APP mode.

- a RA or TA is occurring, and
- TFC not selected on either ND, and
- respective ND is in MAP, MAP CTR, VOR, or APP mode

[Options - Weather Radar Range Arcs and Three Mile Ring]



Indicates relative position of traffic.

- filled red square indicates a resolution advisory (RA)
- filled amber circle indicates a traffic advisory (TA)
- filled white diamond indicates proximate traffic
- unfilled white diamond indicates other traffic

- number is relative or absolute altitude of traffic in hundreds and thousands of feet; not displayed when altitude unknown
- vertical motion arrow indicates traffic climbing or descending at 500 feet per minute or greater; not displayed for vertical motion less than 500 feet per minute

2 TCAS Mode Annunciations

TFC (cyan) –

- TCAS traffic display enabled
- TCAS traffic displayed in MAP, MAP CTR, APP, and VOR modes

TA ONLY (cyan) –

- TCAS cannot provide RAs
- all traffic that would have been RAs are predicted as TAs

3 OFFSCALE Message

Displayed (red) – RA is beyond selected map range

Displayed (amber) – TA is beyond selected map range

4 TCAS No Bearing Messages

RA (red) – data tag displayed for no-bearing RA.

TA (amber) – data tag displayed for no-bearing TA.

Data tag contains distance, altitude, and vertical motion arrow.

5 TCAS/Weather Radar Range Arcs

Displayed when TCAS or weather radar selected; replace range scale ticks.

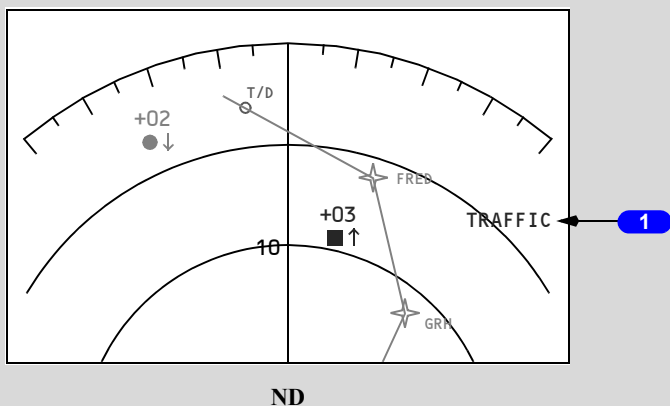
6 TCAS Three Mile Ring

Displayed when TCAS selected and range selected is less than 80 miles.

TCAS Alert Message TRAFFIC

Displayed:

- in all ND modes and ranges
- whether TCAS traffic is displayed or not



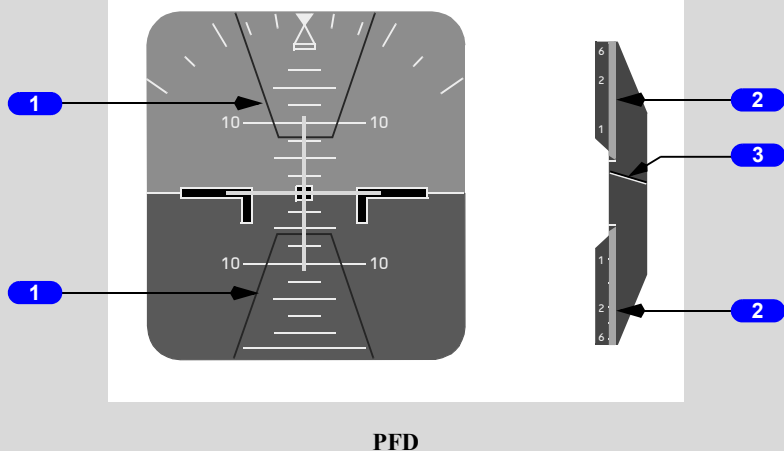
1 TRAFFIC Alert Message

Displayed: (red) – RA is occurring.

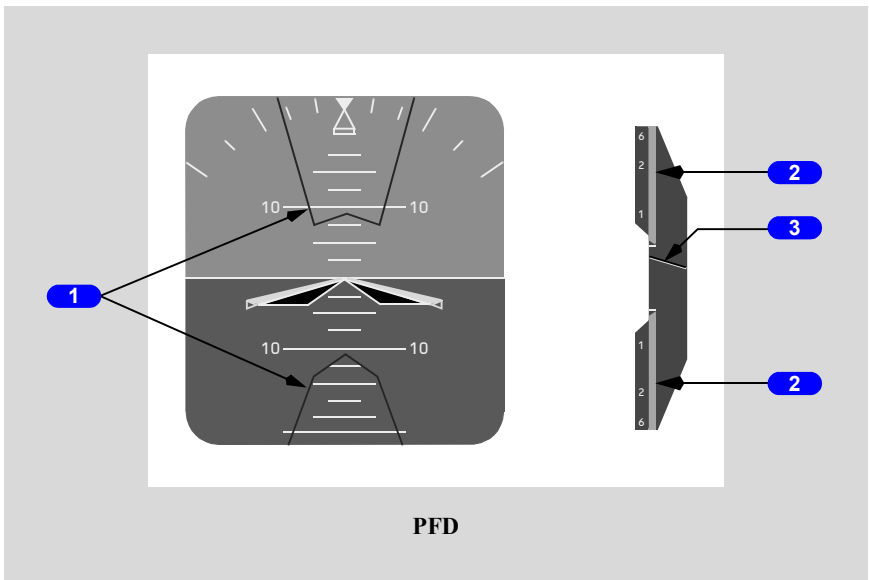
Displayed: (amber) – TA is occurring, and RA is not occurring.

TCAS PFD Vertical Guidance

[Option – VSI TCAS RA Band]



[Option – VSI TCAS RA Band]



1 RA Pitch Region To Avoid (red outlined)

Note: For a single RA, only one red outlined RA pitch region, either above or below, is displayed at a time. For two or more RAs, two red outlined RA pitch regions may be displayed.

To ensure vertical separation, the center of the airplane symbol must be outside the red outlined RA pitch regions to avoid.

2 RA Vertical Speed Region to Avoid (red)

To ensure vertical separation, vertical speed must be outside the red RA vertical speed region to avoid.

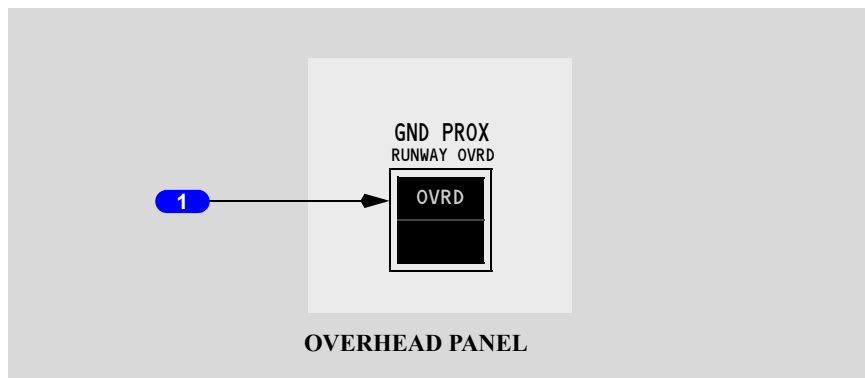
3 Vertical Speed Pointer

Red – present vertical speed does not ensure RA traffic is avoided.

White – present vertical speed ensures RA traffic is avoided.

Ground Proximity Warning System (GPWS) Controls

RAAS Runway Override Control

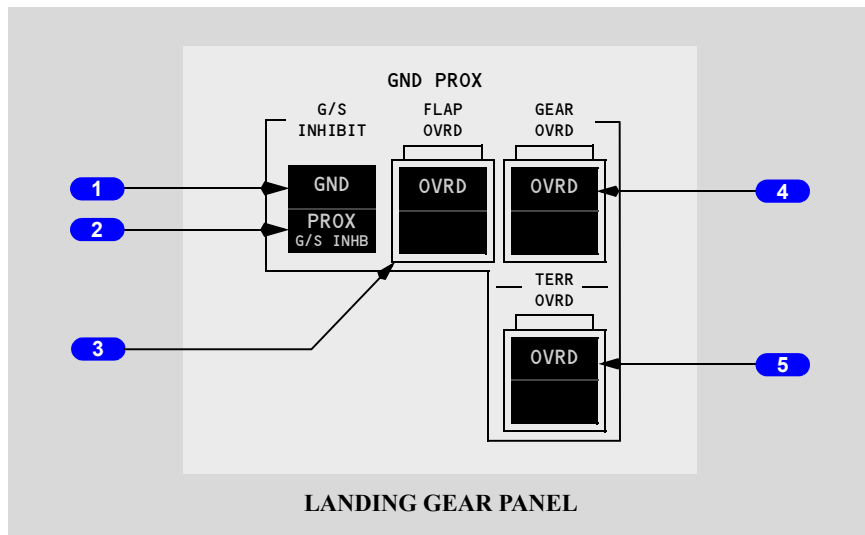


1 RAAS RUNWAY Override (OVRD) Switch

Push (OVRD illuminated) – inhibits RAAS.

Ground Proximity Panel

[Option – Glideslope Inhibit Below 1000 Feet, Basic]



1 Ground Proximity (GND PROX) Glideslope (G/S) INHIBIT (INHIB) Switch

Push – inhibits GLIDE SLOPE alert when pushed below 1,000 feet radio altitude.

2 Ground Proximity (GND PROX) Light

Illuminated (amber) –

- GPWS DON'T SINK, GLIDE SLOPE, SINKRATE, TERRAIN, TOO LOW FLAPS, TOO LOW GEAR, TOO LOW TERRAIN immediate alert is occurring
- inhibited for GLIDE SLOPE, or TOO LOW FLAPS, or TOO LOW GEAR alert when respective inhibit or override switch is pushed

3 Ground Proximity (GND PROX) FLAP Override (OVRD) Switch

Push (OVRD visible) –

- inhibits TOO LOW FLAPS alert
- EICAS advisory message GND PROX SYS will be displayed when airspeed greater than 250 knots for more than 60 seconds

4 Ground Proximity (GND PROX) GEAR Override (OVRD) Switch

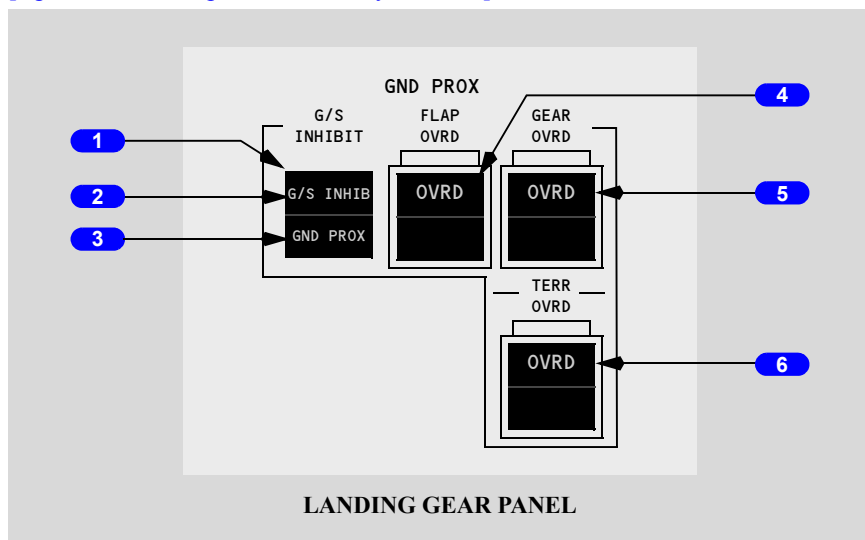
Push (OVRD visible) –

- inhibits TOO LOW GEAR alert
- inhibits CONFIG GEAR alert
- EICAS advisory message GND PROX SYS will be displayed when airspeed greater than 290 knots for more than 60 seconds

5 Ground Proximity (GND PROX) Terrain (TERR) Override (OVRD) Switch

Push (OVRD visible) – inhibits look-ahead obstacle and terrain alerts and display.

[Option – Glideslope Inhibit at Any Altitude]



1 Ground Proximity (GND PROX) Glideslope (G/S) Inhibit Switch

Push – inhibits GLIDE SLOPE alert.

Second push (after five seconds) – enables GLIDE SLOPE alert.

2 Ground Proximity (GND PROX) Glideslope (G/S) Inhibit Light

Illuminated (white) – GLIDE SLOPE alert inhibited.

3 Ground Proximity (GND PROX) Light

Illuminated (amber) –

- GPWS DON'T SINK, GLIDE SLOPE, SINKRATE, TERRAIN, TOO LOW FLAPS, TOO LOW GEAR, TOO LOW TERRAIN immediate alert is occurring
- Inhibited for GLIDE SLOPE, or TOO LOW FLAPS, or TOO LOW GEAR alert when respective inhibit or override switch is pushed

4 Ground Proximity (GND PROX) FLAP Override (OVRD) Switch

Push (OVRD visible) –

- inhibits TOO LOW FLAPS alert
- EICAS advisory message GND PROX SYS will be displayed when airspeed greater than 250 knots for more than 60 seconds

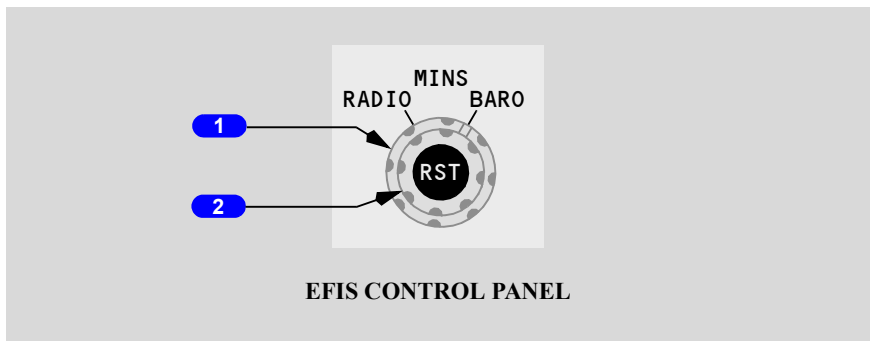
5 Ground Proximity (GND PROX) GEAR Override (OVRD) Switch

Push (OVRD visible) –

- inhibits TOO LOW GEAR alert
- inhibits CONFIG GEAR alert
- EICAS advisory message GND PROX SYS will be displayed when airspeed greater than 290 knots for more than 60 seconds

6 Ground Proximity (GND PROX) Terrain (TERR) Override (OVRD) Switch

Push (OVRD visible) – inhibits look-ahead obstacle and terrain alerts and display.

Radio Altitude/Barometric Altitude Control**1 Minimums (MINS) Selector (outer)**

RADIO – RADIO/BARO control sets RADIO display on PFD and Captain's control sets RADIO reference for GPWS minimums voice annunciation; BARO not displayed.

BARO – RADIO/BARO control sets BARO pointer and BARO display on PFD and Captain's control sets BARO reference for GPWS minimums voice annunciation; RADIO not displayed.

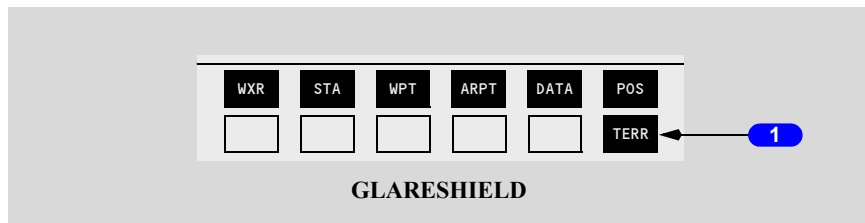
2 RADIO Altitude/Barometric (BARO) Altitude Control (middle)

Rotate –

- when RADIO selected on MINS selector, sets RADIO altitude displayed on PFD
- When BARO selected on MINS selector, sets BARO pointer and BARO display on PFD
- Captain's control sets radio altitude reference for GPWS minimums voice annunciation

GPWS Look-Ahead Terrain Alerting Display and Annunciations

GPWS Terrain Display Select Switch



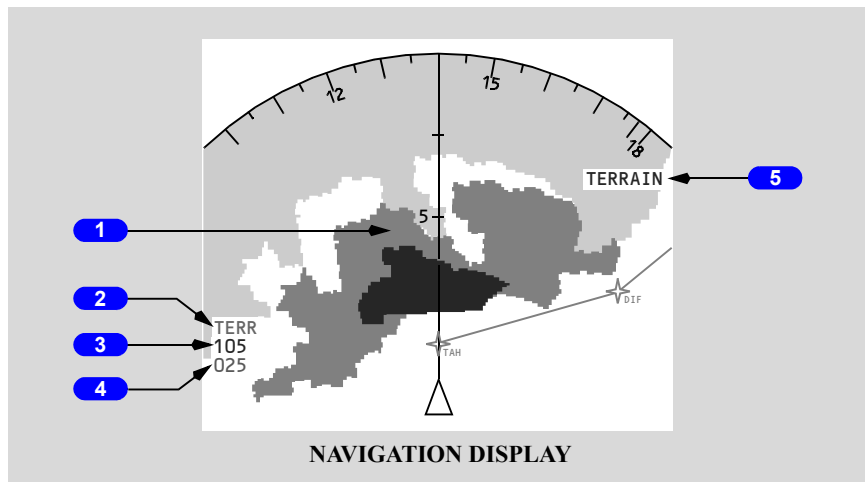
1 Terrain (TERR) Display Select Switch

Push –

- terrain data displayed in MAP, MAP CTR, VOR, and APP modes
- deselects weather radar display regardless of switch position

Second push – deselects terrain data display.

Terrain Display



1 Terrain Display

When airplane is higher than 2,000 feet above terrain, density based on obstacle height, peaks height, and airplane altitude:

- solid green – highest obstacles or peaks displayed
- high density green – intermediate height obstacles or terrain peaks displayed
- low density green – lowest obstacles or terrain peaks displayed

When airplane is lower than 2,000 feet above terrain, color and density based on obstacle height, terrain height, and airplane altitude:

- dotted green – obstacles or terrain from 2,000 feet below to 500 feet (250 feet with gear down) below airplane altitude
- dotted amber – obstacles or terrain 500 feet (250 feet with gear down) below to 2,000 feet above airplane altitude
- dotted red – obstacles or terrain more than 2,000 feet above airplane altitude
- dotted magenta – no terrain data available
- solid amber – look-ahead terrain caution alert is occurring
- solid red – look-ahead terrain warning alert is occurring

Note: In areas without obstacle or terrain data, look-ahead terrain alerting and display functions not available. GPWS immediate alerts function normally.

Note: Terrain more than 2,000 feet below airplane altitude or within 400 feet of nearest airport runway elevation is not displayed.

Displayed automatically when:

- a look-ahead obstacle or terrain alert occurs, and
- TERR not selected on either ND, and
- respective ND is in MAP, MAP CTR, VOR, or APP mode

Display updates with a display sweep similar to weather radar display.

2 Terrain Mode Annunciation

TERR (cyan) – terrain display enabled.

3 Highest Elevation of Obstacle or Terrain Displayed

Color (amber, green, or red) same as color of corresponding obstacle or terrain displayed.

4 Lowest Elevation of Obstacle or Terrain Displayed

Color (amber, green, or red) same as color of corresponding obstacle or terrain displayed.

5 OBSTACLE and TERRAIN Annunciation

ON TAXIWAY (amber) - RAAS on taxiway caution alert is occurring

SHORT RUNWAY (amber) - RAAS short runway caution alert is occurring.

OBSTACLE (amber) – obstacle caution alert is occurring.

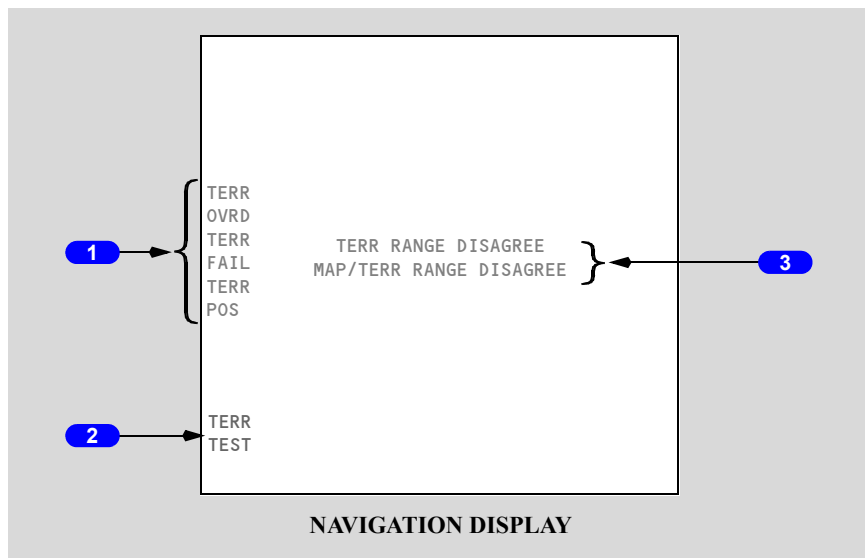
OBSTACLE (red) – obstacle warning alert is occurring.

TERRAIN (amber) – look-ahead terrain caution alert is occurring.

TERRAIN (red) – look-ahead terrain warning alert is occurring.

Displayed in all ND display modes.

Terrain Navigation Display Annunciations



1 Terrain Status Annunciation

TERR FAIL (amber) – Look-ahead terrain alerting and display failed.

TERR OVRD (amber) – TERR OVRD switch pushed.

TERR POS (amber) – Look-ahead terrain alerting and display unavailable due to GPS position uncertainty. During time between GPS position failure and display of TERR POS message, ADIRS provides position for look-ahead terrain alerting and display.

2 Terrain Mode Annunciation

TERR TEST (cyan) – GPWS operating in self-test mode.

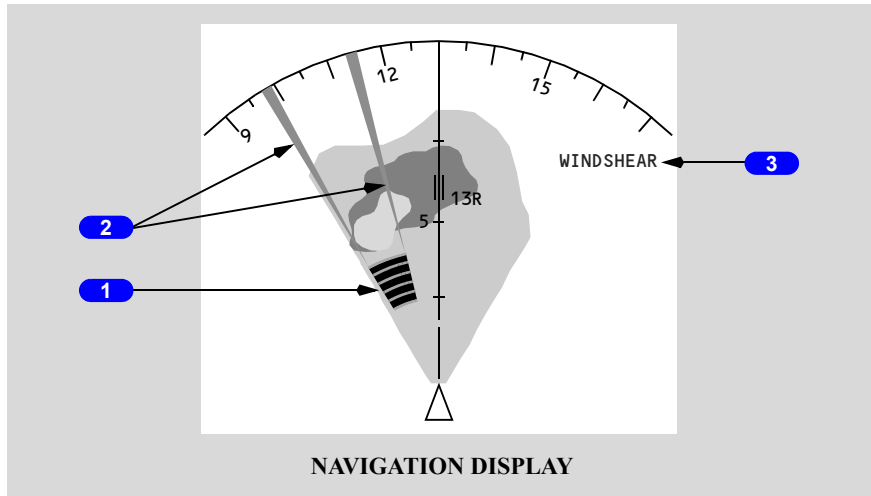
3 Terrain Range Status Annunciation

TERR RANGE DISAGREE (amber) –

- terrain display enabled, and
- terrain output range disagrees with range selected by EFIS control panel

MAP/TERR RANGE DISAGREE (amber) –

- terrain display enabled, and
- terrain output range disagrees with range selected by EFIS control panel, and
- map display output range disagrees with range selected by EFIS control panel

Predictive Windshear (PWS) Display and Annunciations**1 PWS Symbol**

Displayed (red and black) –

- PWS alert is occurring
- displays windshear location and approximate geometric size (width and depth)

Symbol, radials, and weather radar returns displayed automatically when:

- PWS alert occurs, and
- WXR is not selected on either ND, and
- respective ND is in MAP, MAP CTR, VOR, or APP mode

When terrain display is selected and PWS alert occurs, weather radar display replaces terrain display.

2 PWS Radials

Displayed (amber) –

- PWS alert is occurring
- extend from PWS symbol to help locate windshear event

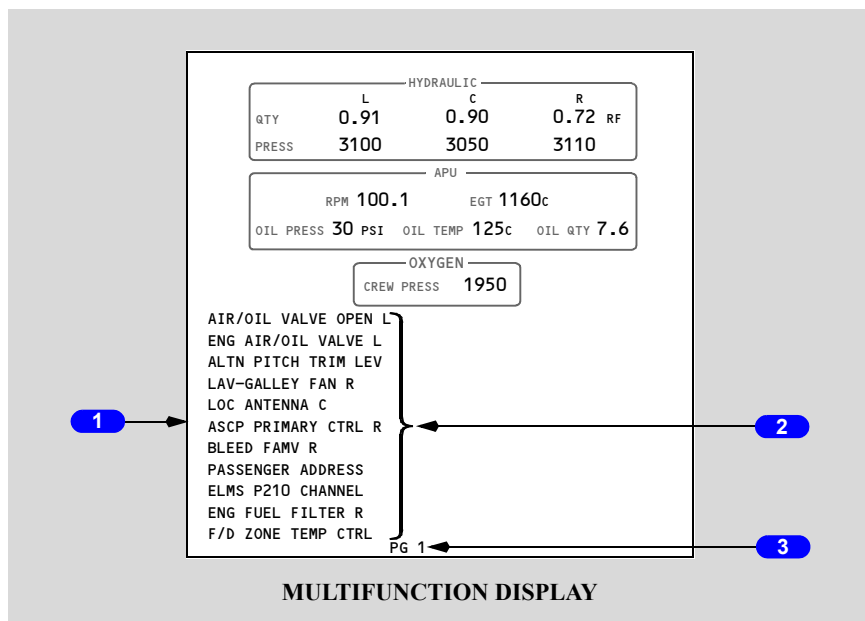
3 WINDSHEAR Annunciation

WINDSHEAR (amber) – PWS caution alert is occurring.

WINDSHEAR (red) – PWS warning alert is occurring.

Displayed in all navigation display modes.

Status Display



1 Status Display

Displays hydraulic, APU, and oxygen system indications and status messages.

2 Status Messages

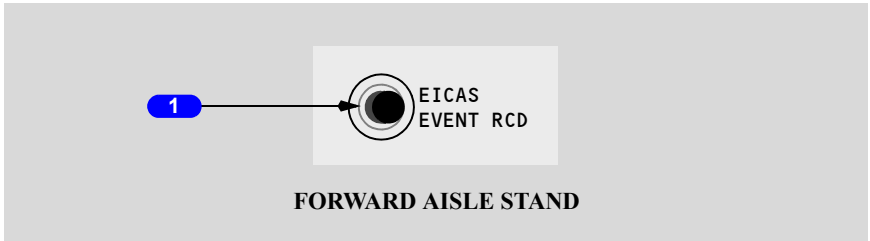
Status messages indicate equipment faults requiring MEL reference for dispatch.

3 Page (PG) Number

Displayed –

- additional pages of status messages exist
- displays number of page selected

EICAS Event Record Switch

**1 EICAS EVENT Record (RCD) Switch**

Push – records up to five EICAS events into memory.

Intentionally
Blank

Warning Systems
System Description**Chapter 15**
Section 20**Introduction**

Warning systems consist of:

- engine indication and crew alerting system (EICAS)
- airspeed alerts
- tail strike detection system
- takeoff and landing configuration warning system
- MCP selected altitude alerts
- crew alertness monitor
- traffic alert and collision avoidance system (TCAS)
- windshear alerts
- ground proximity warning system (GPWS)

Engine Indication and Crew Alerting System (EICAS)

EICAS consolidates engine and airplane system indications and is the primary means of displaying system indications and alerts to the flight crew. The most important indications are displayed on EICAS which is normally displayed on the upper center display.

System Alert Level Definitions**Time Critical Warnings**

Time critical warnings alert the crew of a non-normal operational condition requiring immediate crew awareness and corrective action to maintain safe flight. Master warning lights, voice alerts, and ADI indications or stick shakers announce time critical conditions.

Warnings

Warnings alert the crew to a non-normal operational or system condition requiring immediate crew awareness and corrective action.

Cautions

Cautions alert the crew to a non-normal operational or system condition requiring immediate crew awareness. Corrective action may be required.

Advisories

Advisories alert the crew to a non-normal operational or system condition requiring routine crew awareness. Corrective action may be required.

EICAS Messages

Systems conditions and configuration information is provided to the crew by four types of EICAS messages:

- EICAS alert messages are the primary method to alert the crew to non-normal conditions
- EICAS communication messages direct the crew to normal communication conditions and messages
- EICAS memo messages are crew reminders of certain flight crew selected normal conditions
- EICAS status messages indicate equipment faults which may affect airplane dispatch capability

An EICAS alert, communications, or memo message is no longer displayed when the respective condition no longer exists.

EICAS Alert Messages

From after engine start until engine shut down, EICAS alert messages are the primary means to alert the crew to non-normal conditions which may impact other operations during the flight.

There is a non-normal procedure for each EICAS alert message. The procedure for every EICAS alert message is included as a checklist in the QRH. Procedures for some EICAS alert messages have steps to reconfigure airplane systems. A rectangular symbol  prefaces an alert message that has procedural steps. The rectangular symbol  also prefaces EICAS alert messages for checklists that have notes or information of which the crew must be made aware.

EICAS alert messages are grouped into three priority levels: warning, caution, and advisory. Prioritization is an aid to flight crew decision making when more than one EICAS alert message is displayed.

EICAS warning messages are displayed red and EICAS caution and advisory messages are displayed amber. Red EICAS alert messages remain displayed and cannot be canceled by pushing the CANC/RCL switch. Amber EICAS alert messages can be canceled and recalled by pushing the CANC/RCL switch.

EICAS Communication Messages

EICAS communication messages direct crew attention to normal communication conditions which may require crew attention. There is a crew action for each EICAS communications message.

EICAS communications messages are grouped into three priority levels: high, medium, and low. Prioritization is an aid to flight crew decision making when more than one message is displayed.

EICAS communications messages are displayed in white below EICAS alert messages. Communication messages can not be cancelled by pushing the CANC/RCL switch.

EICAS Memo Messages

EICAS memo messages are crew reminders of certain flight crew selected normal conditions. They are displayed in white at the bottom of the last page of EICAS alert messages on the primary EICAS display.

Pushing the CANC/RCL switch when the last page of EICAS alert messages is displayed ensures all current memo messages have been displayed.

EICAS Status Messages

All EICAS status messages are listed in the Dispatch Deviation Guide (DDG) or airline equivalent and provide a cross reference to the Minimum Equipment List (MEL) for dispatch capability.

Display and Manipulation of EICAS Messages

If more than one EICAS alert message is displayed, the messages are displayed in a list which is grouped by priority level. EICAS warning messages are displayed in red at the top of the message list.

EICAS caution messages are displayed in amber below the lowest warning message. EICAS advisory messages are displayed in amber below the lowest caution message and are indented one character so they may be distinguished from EICAS caution messages.

The most recent EICAS alert message is displayed at the top of its priority group and all messages move down one display line. If a message is no longer displayed because the respective system non-normal condition no longer exists, all messages previously displayed move up one display line.

If there are more messages in the list than can be displayed on one page, multiple pages are created and numbered sequentially. The page number is normally displayed at the bottom of each list. Multiple pages of EICAS caution and advisory messages can be displayed one page at a time by pushing the CANC/RCL switch. If there are more EICAS warning messages in the list than can be displayed on one page, no page number is displayed and it is not possible to display other pages. In all other cases, pushing the CANC/RCL switch displays the next page of EICAS caution and advisory messages. EICAS warning messages are displayed at the top of each page.

Pushing the CANC/RCL switch when the last page of the list is displayed causes all EICAS caution and advisory messages to be no longer displayed.

EICAS alert messages for new system non-normal conditions are displayed on the page being viewed.

For example, if page three is displayed and an EICAS caution message is displayed because a new system non-normal occurs, the message is displayed immediately below any EICAS warning messages. If the CANC/RCL switch is subsequently pushed to redisplay page one, the message is displayed as the first EICAS caution message on page one.

When no EICAS caution or advisory messages are displayed, pushing the CANC/RCL switch redisplay page one of the EICAS caution and advisory messages for all system non-normal conditions and the RECALL message is displayed briefly.

The most recent EICAS communication message is displayed at the top of its priority group and all messages move down one display line. If a message is no longer displayed because the respective communication condition no longer exists, all messages previously displayed move up one display line.

The most recent EICAS memo message is displayed at the bottom of the memo messages.

The STATUS cue is displayed on primary EICAS when a new EICAS status message is displayed. When the STAT switch is pushed, the status display is displayed on the secondary EICAS display. The most recent status message is displayed at the top of the message list.

The STAT switch controls the display of single and multiple pages of status messages in a manner similar to the way the CANC/RCL switch controls the display of EICAS alert messages.

Aurals, Master WARNING/CAUTION Switches and Lights, and GND PROX Light

Aurals, two master WARNING and CAUTION lights, and the GND PROX light call attention to the following alerts:

- in the following table, parans () describe crew action to silence the aural or extinguished the light while the alert is occurring.

Aural	Light	Calls Attention To:
Bell (Silence by pushing Master WARNING/CAUTION Reset switch)	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	EICAS warning message: APU FIRE FIRE CARGO AFT, FWD FIRE ENG L, R FIRE WHEEL WELL

Aural	Light	Calls Attention To:
--------------	--------------	----------------------------

[Option - Siren not resettable]

Siren	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	EICAS warning message: AUTOPILOT DISC CONFIG DOORS CONFIG FLAPS CONFIG GEAR STEERING CONFIG PARKING BRAKE CONFIG RUDDER CONFIG SPOILERS CONFIG STABILIZER OVERSPEED
-------	--	--

[Option - Resettable siren]

Siren (Silence by pushing Master WARNING/CAUTION Reset switch)	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	EICAS warning message: CABIN ALTITUDE PILOT RESPONSE
---	--	--

Voice annunciation VEE ONE	None	Airspeed at V1 during takeoff
Voice annunciation ENGINE FAIL	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	Red ENG FAIL on both PFDs
Beeper	Master CAUTION lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	New EICAS caution message, except: ENG SHUTDOWN ENG SHUTDOWN L ENG SHUTDOWN R
High-low chime	None	New EICAS medium level communication message

Aural	Light	Calls Attention To:
Voice annunciation: DON'T SINK, DON'T SINK TOO LOW, TERRAIN	GND PROX light	GPWS immediate alert.

Aural	Light	Calls Attention To:
Voice annunciation: ADJUST VERTICAL SPEED, ADJUST CLIMB, CLIMB CLIMB, CLIMB NOW, CLIMB, CLIMB NOW CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB DESCEND, DESCEND DESCEND, DESCEND NOW, DESCEND, DESCEND NOW DESCEND, CROSSING DESCEND, DESCEND, CROSSING DESCEND INCREASE CLIMB, INCREASE CLIMB INCREASE DESCENT, INCREASE DESCENT MAINTAIN VERTICAL SPEED, MAINTAIN MAINTAIN VERTICAL SPEED CROSSING, MAINTAIN MONITOR VERTICAL SPEED	None	Red regions to avoid on PFD Red TRAFFIC message and TCAS RA traffic display on ND
Voice annunciation CLEAR OF CONFLICT	None	Red regions to avoid on PFD, Red TRAFFIC message, and TCAS RA traffic display on ND are no longer displayed.
Voice annunciation TRAFFIC, TRAFFIC	None	Amber TRAFFIC message and TCAS TA traffic display on ND

Aural	Light	Calls Attention To:
Voice annunciation: OBSTACLE, OBSTACLE, PULL UP TERRAIN, TERRAIN, PULL UP	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	Red PULL UP on both PFDs Red OBSTACLE or TERRAIN message and obstacle or terrain display on ND
Voice annunciation: CAUTION OBSTACLE CAUTION TERRAIN	GND PROX light	Amber OBSTACLE or TERRAIN message and obstacle or terrain display on ND
Voice annunciation: WINDSHEAR AHEAD GO AROUND, WINDSHEAR AHEAD	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	Red WINDSHEAR on both PFDs Red WINDSHEAR message and PWS display on ND
Voice annunciation MONITOR RADAR DISPLAY	None	Amber WINDSHEAR message and PWS display on ND
Siren, followed by voice annunciation WINDSHEAR, WINDSHEAR, WINDSHEAR	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	Red WINDSHEAR on both PFDs
Voice annunciation PULL UP	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	Red PULL UP on both PFDs
Siren (If caused by Thrust lever at idle, silence by pushing Master WARNING/CAUTION Reset switch)	Master WARNING lights (If caused by Thrust lever at idle, extinguish by pushing Master WARNING/CAUTION Reset switch)	EICAS warning message CONFIG GEAR for: • Thrust lever at idle, and • radio altitude less than 800 feet, and • gear not down and locked.

Aural	Light	Calls Attention To:
Voice annunciation: SINK RATE TERRAIN	GND PROX light	GPWS immediate alert
Voice annunciation: GLIDE SLOPE TOO LOW, FLAPS TOO LOW, GEAR	GND PROX light (Inhibited by pushing the respective GND PROX OVRD switch)	GPWS immediate alert
Altitude voice annunciations	None	Altitude voice annunciations during approach

Flight Deck Panel Annunciator Lights

Flight deck panel annunciator lights are used with EICAS messages to:

- help locate and identify affected systems and controls
 - reduce potential for error
-

Airspeed Voice Annunciations and Alerts

Takeoff V1 Airspeed

The voice annunciation VEE ONE sounds when airspeed reaches V1 during takeoff.

Stall Warning

Warning of an impending stall is provided by left and right stick shakers, which independently vibrate the left and right control columns.

Airspeed Low

The EICAS caution message AIRSPEED LOW is displayed and the box around the current airspeed indication on the PFD is highlighted amber if airspeed is below minimum maneuvering speed.

Overspeed Warning

The EICAS warning message OVERSPEED is displayed if airspeed is greater than VMO/MMO. The message remains displayed until airspeed is reduced below VMO/MMO.

Tail Strike Detection System

The tail strike alert system detects ground contact which could damage the airplane pressure hull. A two inch blade target and two proximity sensors are installed on the aft body of the airplane. The EICAS caution message TAIL STRIKE is displayed when a tail strike is detected.

Takeoff And Landing Configuration Warning System

The takeoff and landing configuration warning system alerts the crew that the airplane is not configured for normal takeoff or normal landing.

Takeoff Configuration Warnings

The respective EICAS warning message CONFIG is displayed if:

- airplane is on the ground, and
- FUEL CONTROL switches are in RUN position, and
- either engine thrust is in takeoff range, and
- thrust reversers are not unlocked or deployed, and
- airspeed is less than V₁, and
- any of the following configurations exist;
 - any door not closed, latched, and locked, or
 - flaps or slats not in takeoff position, or
 - main gear steering not locked, or
 - parking brake set, or
 - rudder trim not centered, or
 - SPEED BRAKE lever not in DOWN detent, or
 - stabilizer trim not in green band

If thrust is decreased below takeoff range and airspeed is less than V₁ but the airplane is still not configured for takeoff, the Master WARNING lights are extinguished and the siren is silenced. The CONFIG message remains displayed until airspeed is less than V₁ and for 10 seconds after thrust is decreased below takeoff range to aid in identifying the takeoff configuration.

Landing Configuration Warning

The landing configuration warning system alerts the crew the landing gear is not extended for landing. The EICAS warning message CONFIG GEAR is displayed if:

- the airplane is in flight, and
- any landing gear is not down and locked, and
- any of the following configurations exist;
 - either Thrust lever closed and radio altitude less than 800 feet, or

- FLAP lever in landing position

If the message is displayed because a Thrust lever is closed at low radio altitudes, the message remains displayed until the Thrust levers are advanced or landing gear is down and locked.

If the message is displayed because the FLAP lever is in landing position, the message remains displayed until the landing gear is down and locked or the GND PROX GEAR OVRD switch is pushed.

Speedbrake Lever Extend Beyond ARM During Climb

[After PRR 63003]

In flight, the EICAS warning message CONFIG SPOILERS is displayed if:

- the SPEEDBRAKE lever is extended beyond ARMED, and
- climb or higher thrust is set on either thrust levers

The message remains displayed until:

- the SPEEDBRAKE lever is DOWN or at ARMED, or
- both thrust levers are set below climb thrust

Configuration Warning System Non-normal Operation

If the takeoff and landing warning system fails, the EICAS advisory message CONFIG WARN SYS will be displayed. If the takeoff and landing configuration system fails, CONFIG messages may or may not be displayed. If the messages are displayed with the CONFIG WARN SYS message, the CONFIG messages may not be correct.

MCP Selected Altitude Alert

Altitude alerting is provided when approaching or departing the altitude selected in the MCP altitude window.

Approaching MCP Selected Altitude

[Option – Basic – 900 Approaching, 200 Departing]

At 900 feet prior to reaching the selected altitude a highlighted white box is displayed around the selected altitude and the current altitude on the PFD. The highlights are no longer displayed when within 200 feet of the selected altitude.

Departing MCP Selected Altitude

When departing the selected altitude by 200 feet, the EICAS alert message ALTITUDE ALERT is displayed, and a highlighted amber box is displayed around the current altitude. The message and amber highlight is no longer displayed when:

- subsequently reapproaching to within 200 feet of the selected altitude, or
- a new MCP altitude is selected, or
- departing more than 900 feet from the selected altitude.

MCP Selected Altitude Alert Inhibits

MCP selected altitude alerts are inhibited when:

- glideslope captured, or
- landing flaps selected and landing gear down and locked.

Crew Alertness Monitor

[Airline selectable option]

The FMC continuously monitors switch action on the MCP, EFIS control panel, display select panel, CDUs, and radio transmitter microphone switches. When a predefined time elapses after the last switch action was detected, the EICAS alert message PILOT RESPONSE is displayed.

The message is inhibited:

- below 20,000 feet,
- during climb, and
- when flaps are not up

Traffic Alert and Collision Avoidance System (TCAS)

TCAS alerts the crew to possible conflicting traffic. TCAS interrogates operating transponders in other airplanes, tracks the other airplanes by analyzing the transponder replies, and predicts the flight paths and positions. TCAS provides TCAS ND messages, voice annunciations, PFD vertical flight path guidance, and traffic displays of the other airplanes to the flight crew. Neither ND messages, voice annunciations, PFD vertical guidance, nor traffic display is provided for other airplanes that do not have operating transponders. TCAS operation is independent of ground-based air traffic control.

TCAS identifies a three-dimensional airspace around the airplane where a high likelihood of traffic conflict exists. The dimensions of this airspace are contingent upon the closure rate with conflicting traffic.

TCAS provides:

- resolution advisory (RA) and display
- traffic advisory (TA) and display
- proximate traffic display
- other traffic display.

TCAS messages and TCAS traffic symbols can be displayed on the ND in the map, map centered, VOR, and approach modes. TCAS messages and TCAS traffic symbols cannot be displayed on the ND in the VOR-centered, approach-centered, or plan modes.

TCAS messages TRAFFIC, TA ONLY, and TCAS TEST may be displayed in all ND modes.

TCAS processing priorities may reduce display of certain air traffic on the ND. Reduced display of air traffic does not affect system collision avoidance alerting capability.

Resolution Advisories (RA) and Display

An RA is a prediction that another airplane will enter the TCAS conflict airspace within approximately 20 to 30 seconds. If altitude data from the other airplane is not available, no RA can be provided.

When TCAS predicts an RA:

- the TCAS red message TRAFFIC is displayed on the ND
- a TCAS voice annunciation sounds
- TCAS PFD vertical guidance is displayed

When the TCAS cyan message TFC is displayed on the ND, and the RA is within the display range of the ND, the TCAS RA Traffic aircraft symbol and its accompanying data tag are displayed on the ND.

The TCAS RA Traffic aircraft symbol is a filled red square. The RA data tag contains the altitude and the vertical motion arrow.

For no-bearing RAs, the red RA label is displayed below the red message, TRAFFIC, and the RA data tag information is displayed to the right of the label. The RA red data tag contains the distance, altitude, and the vertical motion arrow.

When the RA is further from the airplane than the ND range currently displayed, the TCAS red message OFFSCALE is displayed on the ND.

Traffic Advisories (TA) and Display

A TA is a prediction another aircraft will enter the conflict airspace in 25 to 45 seconds. TAs assist the flight crew in establishing visual contact with the other aircraft.

When TCAS predicts a TA:

- the TCAS amber message TRAFFIC is displayed on the ND
- the TCAS voice annunciation TRAFFIC, TRAFFIC sounds once

When the TCAS cyan message TFC is displayed on the ND and the TA is within the display range of the ND, the TCAS TA Traffic aircraft symbol and its accompanying data tag are displayed on the ND.

The TA Traffic aircraft symbol is a filled amber circle. The TA data tag contains the altitude and vertical motion arrow.

For no-bearing TAs, the amber TA label is displayed below the TRAFFIC message, and the TA data tag information is displayed to the right of the label. The TA labels are displayed below the RA labels. The TA data tag contains the distance, altitude, and vertical motion arrow.

When the TA is further from the airplane than the ND range currently displayed, the TCAS amber message OFFSCALE is displayed on the ND.

Proximate Traffic Display

Proximate traffic is another airplane that is neither an RA or a TA but is within:

- six miles
- 1,200 feet vertically.

When the TCAS cyan message TFC is displayed on the ND, and the Proximate Traffic aircraft is within the ND display range, the TCAS Proximate Traffic aircraft symbol is displayed on the ND.

The TCAS Proximate Traffic aircraft symbol is a filled white diamond. When TCAS is receiving and processing altitude data from the Proximate Traffic aircraft, the proximate traffic data tag is displayed on the ND. The proximate traffic data tag contains the altitude and vertical motion arrow.

Other Traffic Display

Other Traffic aircraft is an aircraft that is within the ND display limits but is neither a RA, a TA, or proximate traffic aircraft. When TCAS is not receiving and processing altitude data from the Other Traffic aircraft, the Other Traffic aircraft becomes Proximate Traffic aircraft automatically when within six miles.

When the TCAS cyan message TFC is displayed on the ND and the Other Traffic aircraft is within the ND display range, the TCAS Other Traffic symbol is displayed on the ND.

The TCAS Other Traffic symbol is a hollow white diamond. When TCAS is receiving and processing altitude data from the Other Traffic aircraft, a data tag like that described in Proximate Traffic Display is displayed.

TCAS PFD Vertical Guidance

When TCAS predicts an RA, TCAS vertical guidance is displayed on the PFD for a maneuver to ensure vertical separation. Traffic avoidance is ensured by adjusting or maintaining a pitch attitude and vertical speed outside the red RA regions.

If the traffic airplane also has TCAS and a mode S transponder, TCAS vertical guidance is coordinated with the traffic aircraft TCAS.

TCAS ND Messages

ND Message	Color	Description
TFC	Cyan	TCAS traffic display enabled. Inhibited if following TCAS messages are displayed: TCAS FAIL, TCAS OFF, TCAS TEST
TRAFFIC	Amber	TA is occurring.
OFFSCALE	Amber	TA is occurring at range greater than current ND range. Replaced by red OFFSCALE when RA is also occurring at range greater than current ND range.
TRAFFIC	Red	RA is occurring.
OFFSCALE	Red	RA is occurring at range greater than current ND range.
TA ONLY	Cyan	TCAS can not provide RAs. All traffic that would have been RAs are predicted as TAs.
TCAS FAIL	Amber	TCAS failed, or TCAS information cannot be displayed on ND.
TCAS OFF	Amber	TFC switch pushed to display traffic but TCAS not selected on transponder panel.
TCAS TEST	Cyan	TCAS in test mode. Message is displayed on all ND modes and ranges.

TCAS Voice Annunciations

Voice Annunciation	Condition	Response
TRAFFIC, TRAFFIC	New TA, initial voice annunciation.	Attempt to visually locate the traffic.
MONITOR VERTICAL SPEED	New RA, initial voice annunciation. Present pitch attitude and vertical speed are outside the red RA regions.	Continue to keep pitch attitude and vertical speed outside the red RA regions.
MAINTAIN VERTICAL SPEED, MAINTAIN	New RA, initial voice annunciation. Present pitch attitude and vertical speed are outside the red RA regions.	
MAINTAIN VERTICAL SPEED CROSSING, MAINTAIN	New RA, initial voice annunciation. Present pitch attitude and vertical speed are outside the red RA regions. Airplane will pass through the altitude of the traffic.	
CLIMB, CLIMB	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA regions.	
CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA regions. Airplane will climb through the altitude of the traffic.	Increase pitch attitude and vertical speed to remain outside the red RA regions.

Voice Annunciation	Condition	Response
DESCEND, DESCEND	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA regions.	Decrease pitch attitude and vertical speed to remain outside the red RA regions.
DESCEND, CROSSING DESCEND DESCEND, CROSSING DESCEND	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA regions. Airplane will descend through the altitude of the traffic.	
INCREASE CLIMB, INCREASE CLIMB	Existing RA, TCAS requires change in vertical rate.	Adjust pitch attitude and vertical speed to remain outside the red RA regions.
INCREASE DESCENT, INCREASE DESCENT	Present pitch attitude and vertical speed are within the red RA regions.	
ADJUST VERTICAL SPEED, ADJUST	Existing RA, minimum vertical speed required to ensure separation has decreased, present pitch attitude and vertical speed are outside the red RA regions, or, new RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA regions.	Continue to keep pitch attitude and vertical speed outside the red RA regions. Vertical speed may be decreased, or, change pitch attitude and vertical speed to remain outside the red RA regions.
DESCEND, DESCEND NOW, DESCEND, DESCEND NOW	Existing RA, previous TCAS vertical guidance was to climb. Present pitch attitude and vertical speed are within the red RA regions.	Decrease pitch attitude and vertical speed to remain outside the red RA regions.

Voice Annunciation	Condition	Response
CLIMB, CLIMB NOW, CLIMB, CLIMB NOW	Existing RA, previous TCAS vertical guidance was to descend. Present pitch attitude and vertical speed are within the red RA regions.	Increase pitch attitude and vertical speed to remain outside the red RA regions.
CLEAR OF CONFLICT	TCAS PFD vertical guidance is no longer displayed and traffic changes to a TA symbol. Separation is increasing and the RA will not occur. However, the voice annunciation will not sound if TCAS can no longer predict the track of the RA aircraft.	Attempt to visually locate the traffic.

TCAS Normal Operation

TCAS is controlled from the transponder panel. TA/RA is normally selected. However, it is sometimes necessary to select TA ONLY to prevent nuisance RAs.

TCAS is controlled from the transponder panel. TA/RA is normally selected. However, it is sometimes necessary to select TA to prevent nuisance RAs.

TA ONLY is selected during engine out operations to prevent RAs when adequate thrust is not available to follow the RA commands.

TA is selected during engine out operations to prevent RAs when adequate thrust is not available to follow the RA commands.

TCAS Non–Normal Operation

The EICAS advisory message TCAS is displayed and the amber TCAS FAIL message is displayed on both NDs if TCAS is failed.

The EICAS advisory message TCAS OFF is displayed and the amber TCAS OFF message is displayed on both NDs if TCAS if the TFC switch is pushed when the airplane is below 400 feet radio altitude. TCAS remains in standby mode.

The respective EICAS advisory message TCAS RA CAPTAIN or TCAS RA F/O is displayed if RA guidance cannot be displayed on the respective PFD. The ND traffic displays and voice alerts are unaffected.

Ground Proximity Warning System (GPWS)

Introduction

GPWS provides alerts and annunciations for:

- runway awareness on the ground and in flight
- look-ahead obstacle and terrain alerts for potentially hazardous flight conditions involving impact with the obstacles and the ground
- predictive windshear alerts and immediate windshear alerts
- bank angle voice alerts
- altitude voice annunciations during approach

Runway Awareness and Advisory System (RAAS)

The RAAS provides voice annunciations and ND messages to assist flight crew awareness of airplane position during ground operations, approach to landing, and go-around. The airports in the RAAS airport database include details for every runway on the airport.

Note: RAAS voice annunciations and ND messages are based upon RAAS database runway details. RAAS voice annunciations and ND messages are not based upon the runway intended or planned. RAAS voice annunciations and ND messages do not take into account airplane performance factors such as airplane weight, wind, runway condition, slope, air temperature, or airport altitude. The absence of RAAS voice annunciations and ND messages does not ensure that a runway is appropriate for takeoff or landing. RAAS voice annunciations and ND messages do not ensure that a runway is inappropriate for takeoff or landing. Flight crew is responsible to use other means available to ensure correct runway selection and the performance calculations are accurate for the conditions.

When the GPWS Terrain switch is pushed on, the TERR symbol is displayed and RAAS messages will be displayed on the ND.

In flight RAAS voice annunciations and ND messages are enabled or inhibited based on an algorithm that numerically subtracts the landing runway touchdown zone elevation in the GPWS database from the pressure altitude of the airplane. The term "above field elevation" is used in the system description for these altitudes.

[Options – Each voice annunciation and ND message is a selectable option.]

Voice Annunciations and ND Messages During Taxi and Takeoff on RAAS Airports

Voice Annunciation and ND Message	Description
Voice annunciation: CAUTION ON TAXIWAY, ON TAXIWAY ND amber message: ON TAXIWAY	Sounds once each time the airplane: • is on a surface other than a runway, and • ground speed is greater than 40 knots
APPROACHING (RUNWAY IDENTIFIER of runway end closest to airplane position)	Sounds once each time the airplane: • approaches a runway, and • ground speed is less than 40 knots
APPROACHING RUNWAYS	Sounds once each time the airplane: • approaches two runways within 20 degrees of each other, and • ground speed is less than 40 knots
ON RUNWAY (RUNWAY IDENTIFIER)	Sounds once when the airplane:: • enters a runway, and • heading is within 20 degrees of the runway heading
ON RUNWAY (RUNWAY IDENTIFIER) (LENGTH) REMAINING	Sounds once when the airplane:: • enters a runway with available runway length for takeoff less than the defined length required, and • heading is within 20 degrees of the runway heading
ON RUNWAY (RUNWAY IDENTIFIER)	Sounds when the airplane: • remains on the runway, and • moves less than 100 feet after entering runway, and • heading is within 20 degrees of the runway heading, and
Voice annunciation: CAUTION SHORT RUNWAY, SHORT RUNWAY ND amber message: SHORT RUNWAY	Sounds once when the airplane:: • is on a runway with available runway length for takeoff less than the defined length required, and • heading is within 20 degrees of the runway heading, and • ground speed is greater than 40 knots

Voice Annunciations and ND Messages During Approach, Landing, Go-Around, and RTO on RAAS Airports

Voice Annunciation and ND Message	Description
APPROACHING (RUNWAY IDENTIFIER)	Sounds once each time the airplane: • approaches within three nautical miles of a runway threshold, and • is within 20 degrees of the runway heading, and • is within approximately 200 feet plus one runway width of the runway extended center line, and • is between 750 feet and 300 feet above field elevation The voice annunciation is delayed and sounds at 450 feet altitude if the voice annunciation would have sounded when the airplane was between 550 feet and 450 feet above field elevation.
APPROACHING RUNWAYS	Sounds once each time the description is met while approaching two runways
APPROACHING (RUNWAY IDENTIFIER) (FEET) AVAILABLE	Sounds once each time the airplane: • approaches within three nautical miles of a runway threshold, and • is within 20 degrees of the runway heading, and • is within approximately 200 feet plus one runway width of the runway extended center line, and • is between 750 feet and 300 feet above field elevation The voice annunciation is delayed and sounds at 450 feet altitude if the voice annunciation would have sounded when the airplane was between 550 feet and 450 feet above field elevation.
Voice annunciation: CAUTION SHORT RUNWAY, SHORT RUNWAY ND amber message: SHORT RUNWAY	Sounds once each time the airplane: • approaches within three nautical miles of a runway threshold with available runway length for takeoff less than the defined length required, and • is within 20 degrees of the runway heading, and • is within approximately 200 feet plus one runway width of the runway extended center line, and • is between 450 and 300 feet above field elevation

Voice Annunciation and ND Message	Description
(FEET) REMAINING	Sounds once each time the airplane is on the ground:: • with ground speed greater than 40 knots, and • is on a defined minimum length from the runway end • during rejected takeoff, when ground speed during takeoff decreases by seven knots from the maximum ground speed achieved
	Sounds once each time the airplane is in the air: • less than 100 feet above the runway, and • is over a defined minimum length from the runway end • during go-around after the voice annunciation REMAINING sounds, the voice annunciations continue to sound until the airplane is: • higher than 100 feet above the runway, or • rate of climb is greater than 450 feet per minute
ONE HUNDRED REMAINING	Sounds once each time the airplane: • is within 20 degrees of the runway heading, and • is within 100 feet of the end of a runway, and • ground speed is less than 40 knots

Look-ahead Obstacles and Peaks Terrain Alerting System

Look-ahead obstacles and peaks terrain alerts are provided by monitoring obstacle and terrain proximity using a world-wide terrain data base and an obstacle data base. The obstacle data base is not yet world wide. Terrain data is not designed to be an independent navigation aid.

Proximate obstacle and terrain data may be displayed on the ND. If there is a potential obstacle or terrain hazard, look-ahead alerts are provided based on estimated time to impact.

Estimated time to impact is based on airplane position, altitude, present track, vertical path, and ground speed. FMC VNAV and LNAV path is not considered in the estimated time to impact.

Altitude used for look-ahead terrain mode alerts are a weighted combination of radio altitude, barometric altitude, GPS, and previous flight path. Weighting is reduced for an altitude source which becomes less reliable.

Note: Obstacles or terrain ahead of the airplane may exceed available climb performance. A GPWS caution or warning does not guarantee obstacle or terrain clearance.

777 Flight Crew Operations Manual

When the TERR switch is pushed on, the TERR symbol is displayed on the ND and obstacle and terrain contours may be displayed. When obstacle and terrain contours are displayed, the altitudes of the highest and lowest displayed obstacle or terrain are displayed below the TERR symbol. The color of each altitude corresponds to the altitude of the respective contour.

When the airplane is higher than 2,000 feet above the terrain, obstacles and terrain peaks are displayed using solid, high density, and low density contours of green. The highest obstacles or terrain is represented by solid green, and the lowest obstacles or terrain displayed is represented by low density green.

When the airplane is lower than 2,000 feet above the terrain, all obstacles and terrain within 2,000 feet of airplane barometric altitude is displayed on the navigation display.

When an obstacle or terrain alert occurs, the respective message is displayed on the ND. When an OBSTACLE alert occurs while a TERRAIN alert message is displayed, the OBSTACLE alert message replaces the TERRAIN alert message. Both messages will not be displayed at the same time.

The terrain display is correlated to GPS position, or to ADIRU position if GPS position is intermittently unavailable.

Terrain and weather radar cannot be simultaneously displayed on the ND. When one pilot selects terrain and the other pilot selects weather radar, each display updates on alternating sweeps.

GPWS Look-Ahead Obstacle and Peaks Terrain Alerts

Voice Annunciation	PFD and ND Display and Light	Description
OBSTACLE, OBSTACLE, PULL UP	Red PULL UP on both PFDs Master WARNING lights Red OBSTACLE message on both NDs Solid red obstacle on ND	20 to 30 seconds from projected impact with obstacle. Pushing the GND PROX TERR OVRD switch to OVRD inhibits the alert.

Voice Annunciation	PFD and ND Display and Light	Description
TERRAIN, TERRAIN, PULL UP	Red PULL UP on both PFDs Master WARNING lights Red TERRAIN message on both NDs Solid red terrain on ND	20 to 30 seconds from projected impact with terrain. Pushing the GND PROX TERR OVRD switch to OVRD inhibits the alert.
CAUTION OBSTACLE	Amber OBSTACLE message on both NDs Solid amber obstacle on ND GND PROX light	40 to 60 seconds from projected impact with obstacle. Pushing the GND PROX TERR OVRD switch to OVRD inhibits the alert.
CAUTION TERRAIN	Amber TERRAIN message on both NDs Solid amber terrain on ND GND PROX light	40 to 60 seconds from projected impact with terrain. Pushing the GND PROX TERR OVRD switch to OVRD inhibits the alert.
TOO LOW, TERRAIN	Amber TERRAIN message on both NDs GND PROX light	Descent below unsafe altitude while too far from any airport in the terrain database. Pushing the GND PROX TERR OVRD switch to OVRD inhibits the alert.

Predictive Wind Shear (PWS) and Immediate Windshear Alerting Systems

Windshear alerts are enabled during takeoff, approach, and landing:

- PWS provides windshear alerts when an excessive windshear condition is detected ahead of the airplane
- immediate windshear alerts are provided when an excessive downdraft or tailwind is occurring

PWS Alerting System

Weather radar uses radar imaging to detect disturbed air ahead of the airplane.

777 Flight Crew Operations Manual

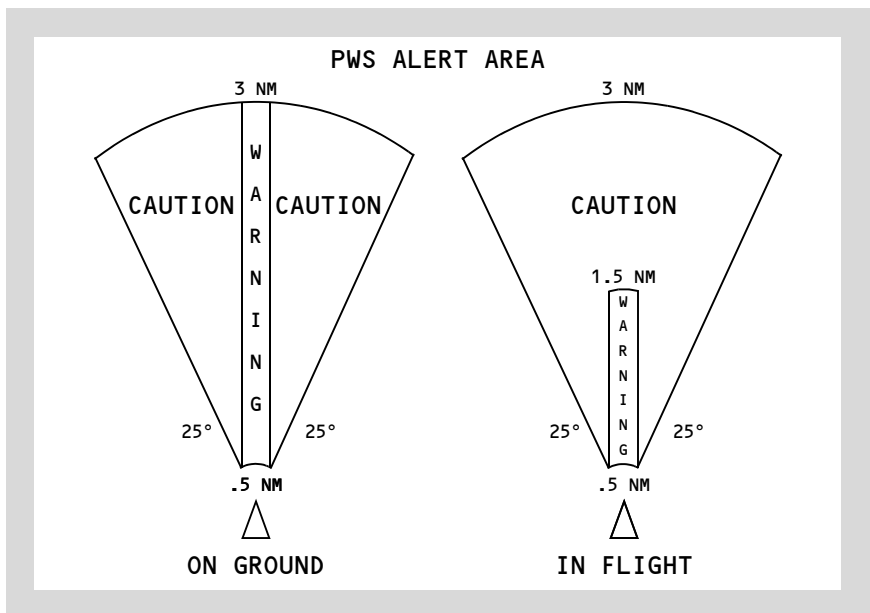
PWS is enabled to provide windshear alerts 12 seconds after weather radar begins scanning for windshear.

When PWS is scanning for windshear, radar antenna scan sweep is reduced.

Prior to takeoff, PWS alerts can be enabled by pushing the WXR switch on the EFIS control panel. On the ground with the WXR switch pushed or not pushed, weather radar begins scanning for windshear when the thrust of either engine is in the takeoff range and thrust reversers are not unlocked or deployed.

In flight with the WXR switch pushed or not pushed, weather radar begins scanning for windshear below 2,300 feet radio altitude and PWS alerts are enabled below 1,200 feet radio altitude.

When windshear is not predicted by PWS, weather radar returns are displayed only when the WXR on the EFIS control panel is pushed.



PWS Alerts

Voice Annunciation	PFD and ND Display and Light	Description
WINDSHEAR AHEAD, WINDSHEAR AHEAD	Red WINDSHEAR on both PFDs Master WARNING lights Red WINDSHEAR message on both NDs RED windshear symbol on ND	Windshear predicted close to and directly ahead of airplane. Enabled during takeoff, below 1,200 feet radio altitude. Windshear position displayed by PWS symbol on the ND in MAP, MAP CTR, VOR, or APP modes only.
GO AROUND, WINDSHEAR AHEAD	Red WINDSHEAR on both PFDs Master WARNING lights Red WINDSHEAR message on both NDs RED windshear symbol on ND	Windshear predicted within 1.5 miles and directly ahead of the airplane. Enabled during approach, below 1,200 feet radio altitude. Windshear position displayed by PWS symbol on the ND in MAP, MAP CTR, VOR, or APP modes only.
MONITOR RADAR DISPLAY	Amber WINDSHEAR message on both NDs RED windshear symbol on ND	Windshear predicted within 3 miles and ahead of the airplane. Enabled during takeoff and approach, below 1,200 feet radio altitude. Windshear position displayed on PWS on ND in MAP, MAP CTR, VOR, or APP modes only.

Note: Weather radar provides windshear alerts for windshear events containing some level of moisture or particulate matter.

Note: Weather radar detects microbursts and other windshears with similar characteristics. Weather radar does not provide alerting for all types of windshear. The flight crew must continue to rely on traditional windshear avoidance methods.

Immediate Windshear Alerts

Voice Annunciation	PFD Display and Light	Description
(Siren) WINDSHEAR, WINDSHEAR, WINDSHEAR	Red WINDSHEAR on both PFDs Master WARNING lights	Excessive windshear detected by GPWS. Enabled below 1,500 feet radio altitude. GPWS windshear detection begins at rotation.

Bank Angle Voice Annunciations**[Option - Bank Angle]**

The voice alert BANK ANGLE sounds if bank angle exceeds 35°, 40°, and 45°.

Immediate Alerting System

Voice Annunciation	PFD and ND Display and Light	Description
DON'T SINK	GND PROX light	Altitude loss with flaps and/or gear up after takeoff or go-around.
GLIDE SLOPE	GND PROX light	Excessive deviation below glide slope. Volume and repetition rate increase as deviation increases. Pushing the GND PROX G/S INHIB switch inhibits the alert.
DON'T SINK	GND PROX light	Altitude loss with flaps and/or gear up after takeoff or go-around.
GLIDE SLOPE	GND PROX light	Excessive deviation below glide slope. Volume and repetition rate increase as deviation increases. Pushing the GND PROX G/S INHIB switch inhibits the alert when pushed below 1,000 feet radio altitude.
PULL UP	Red PULL UP message on both PFDs Master WARNING lights	Follows SINK RATE alert when descent rate becomes severe, or follows TERRAIN alert with flaps and/or gear not in landing configuration when excessive terrain closing rate continues.
SINK RATE	GND PROX light	Excessive descent rate.
TERRAIN	GND PROX light	Excessive terrain closing rate.

Voice Annunciation	PFD and ND Display and Light	Description
TOO LOW, FLAPS	GND PROX light	Unsafe terrain clearance with flaps not in landing configuration at low altitude and airspeed. Pushing the GRND PROX FLAP OVRD switch to OVRD inhibits the alert.
TOO LOW, GEAR	GND PROX light	Unsafe terrain clearance with gear not in landing configuration at low altitude and airspeed with gear not down. Pushing the GRND PROX GEAR OVRD switch to OVRD inhibits the alert.
TOO LOW, TERRAIN	GND PROX light	Follows DON'T SINK alert with gear and/or flaps up after takeoff or go-around for altitude loss at low altitude, or unsafe terrain clearance with gear and/or flaps not in landing configuration at low altitude and airspeed. Pushing the GRND PROX FLAP OVRD switch to OVRD inhibits the alert, when the alert is due to flaps not in landing position. Pushing the GRND PROX GEAR OVRD switch to OVRD inhibits the alert, when the alert is due to gear not down.

Altitude Voice Annunciations During Approach

GPWS provides the following altitude voice annunciations during approach:

[Option - Smart 500 Voice Annunciation]

- 500 feet – FIVE HUNDRED, when glideslope or localizer not received, or glideslope or localizer deviation greater than two dots
- 50 feet – FIFTY
- 40 feet – FORTY
- 30 feet – THIRTY
- 20 feet – TWENTY
- 10 feet – TEN

[Basic - without Smart 500 Voice Annunciation]

- 50 feet – FIFTY
- 40 feet – FORTY
- 30 feet – THIRTY

- 20 feet – TWENTY
- 10 feet – TEN

Minimums Voice Annunciation

GPWS provides the voice annunciation PLUS HUNDRED at 100 feet above the altitude set by the Captain's MINS selector on the EFIS Control Panel and the voice annunciation MINIMUMS at the altitude set.

GPWS Non-Normal Operation**Altitude Voice Annunciations During Approach Non-Normal Operation**

If there is a fault in voice annunciations during the approach system, the EICAS advisory message ALT CALLOUTS is displayed and GPWS annunciations during the approach are inhibited.

RAAS Non-Normal Operation

If the RAAS Runway Override switch is in OVRD, the EICAS advisory message RUNWAY OVRD is displayed and RAAS voice annunciations and ND messages are inhibited.

If GPS position is uncertain, the EICAS advisory message RUNWAY POS is displayed and RAAS voice annunciations and ND messages are inhibited.

If there is a fault in RAAS or the airport is not in the GPWS RAAS database, the EICAS advisory message RUNWAY SYS is displayed and RAAS voice annunciations and ND messages are inhibited.

Windshear Alert Non-Normal Operation

If there is a fault in the immediate windshear system or in the PWS system, the EICAS advisory message WINDSHEAR SYS is displayed and the voice alert WINDSHEAR and the PFD alert WINDSHEAR are inhibited.

Look-Ahead Alert Non-Normal Operation

If there is a fault in look-ahead terrain alert, the respective terrain status annunciation TERR is displayed.

Immediate Alert Non-Normal Operation

If there is a fault in any immediate alert, the respective alert is inhibited. If a fault occurs in any immediate alert other than windshear, there is no indication to the flight crew of which alerts are inhibited. GPWS will continue to provide immediate alerts for which no fault has occurred.

Alert Inhibits

Alerts are inhibited when they are operationally unnecessary or inappropriate. Alerts are inhibited during normal system operation, and during part of the takeoff and landing to prevent distracting the crew.

GPWS immediate windshear alert inhibits all PWS, TCAS, and other GPWS alerts.

When TA/RA is selected on the transponder panel and a GPWS or PWS warning alert occurs, TCAS automatically inhibits RA mode. During the inhibit, all aircraft that would have been predicted as an RA are predicted as a TA. When GPWS and PWS warning alerts are no longer occurring, the RA mode inhibit ends.

Alert Messages Inhibited During Normal System Operation

Certain EICAS alert messages are time delayed, even though related flight deck panel annunciator lights are illuminated. Time delay inhibits prevent normal in-transit indications from being displayed as EICAS alert messages. For example, valves are generally only sensed open or closed, not in-transit. When a valve is in-transit, the message indicating the valve has failed to open or close is inhibited to allow the valve time to move to the commanded position. If the valve is not in the commanded position at the end of the inhibit time delay, the respective EICAS alert message is displayed.

Alert Messages Inhibited By Other Alert Messages

Some EICAS alert messages are inhibited if another related alert message is displayed. For example, individual hydraulic pump pressure messages are inhibited if a hydraulic system pressure message is displayed.

Voice Annunciation Inhibits

Voice annunciations for warning alerts inhibit new voice annunciations for caution alerts.

All voice annunciations are prioritized to aid flight crew decision making when more than one alert could occur.

Altitude voice annunciations during approach inhibit RAAS voice annunciations.

ND Display Alert Inhibits and Automatic Display

Alert displays on the NDs are prioritized to aid flight crew decision making when more than one alert occurs. The displays are also prioritized when neither ND is in MAP, MAP CTR, VOR, or APP mode.

Immediate windshear alert inhibits the automatic display of a new TCAS, look-ahead terrain, or PWS alerts.

TCAS traffic can be displayed concurrently with either TERR and WXR display.

New TCAS TRAFFIC TA or RA alerts:

- When both NDs are in MAP, MAP CTR, VOR, or APP mode and a new TCAS TA or RA alert occurs, TFC is selected automatically for both NDs and TCAS traffic is displayed on both NDs.
- When only one ND is in MAP, MAP CTR, VOR, or APP mode and a new TCAS TA or RA alert occurs, TFC is selected automatically for that ND and TCAS traffic is displayed. The ND not in MAP, MAP CTR, VOR, or APP mode is armed for TCAS display and TFC will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected.
- When neither ND is in MAP, MAP CTR, VOR, or APP mode and a new TCAS TA or RA alert occurs, both NDs are armed for TCAS display and TFC will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected.

New look-ahead terrain alerts:

- When both NDs are in MAP, MAP CTR, VOR, or APP mode and a new look-ahead terrain alert occurs, TERR is selected automatically for both NDs.
- When only one ND is in MAP, MAP CTR, VOR, or APP mode and a new look-ahead terrain alert occurs, TERR is selected automatically for that ND. The ND not in MAP, MAP CTR, VOR, or APP mode is armed for TERR display and TERR will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected. TERR is disarmed by selecting WXR prior to selecting MAP, MAP CTR, VOR, or APP mode.
- When neither ND is in MAP, MAP CTR, VOR, or APP mode and a new look-ahead terrain alert occurs, both NDs are armed for TERR display and TERR will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected. TERR is disarmed for either ND by selecting WXR prior to selecting MAP, MAP CTR, VOR, or APP mode on the respective ND.
- When a RAAS SHORT RUNWAY alert occurs and a GPWS TERRAIN alert occurs the ND message SHORT RUNWAY is inhibited and is replaced by the ND message TERRAIN.

New PWS alerts:

- When both NDs are in MAP, MAP CTR, VOR, or APP mode and a new PWS alert occurs, WXR is selected automatically for both NDs.
- When only one ND is in MAP, MAP CTR, VOR, or APP mode and a new PWS alert occurs, WXR is selected automatically for that ND. The ND not in MAP, MAP CTR, VOR, or APP mode is armed for WXR display and WXR will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected. WXR is disarmed by selecting TERR prior to selecting MAP, MAP CTR, VOR, or APP mode.
- When neither ND is in MAP, MAP CTR, VOR, or APP mode and a new PWS alert occurs, both NDs are armed for WXR display and WXR will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected. WXR is disarmed by selecting TERR prior to selecting MAP, MAP CTR, VOR, or APP mode.

Alerts Inhibited Before Engine Start and After Shutdown

Alert Inhibited	For Message	Inhibit Occurs
Master CAUTION lights Beeper	For all EICAS caution messages	On the ground, and both FUEL CONTROL switches in CUTOFF
Respective EICAS messages: BLEED OFF ELEC BACKUP GEN ELEC DRIVE, ELEC GEN OFF ENG OIL PRESS HYD PRESS PRI	For EICAS caution messages: ENG SHUTDOWN L ENG SHUTDOWN R ENG SHUTDOWN	On the ground, and both FUEL CONTROL switches in CUTOFF

Alerts Inhibited During Engine Start

Alert Inhibited	Inhibit Begins	Inhibit Ends
All new EICAS caution and advisory messages, except: APU LIMIT APU SHUTDOWN ENG AUTOSTART ENG FUEL VALVE ENG SHUTDOWN ENG START VALVE ENG STARTER CUTOUT OVERHEAT ENG	Engine START /IGNITION selector to START	Engine reaches idle RPM, or start is aborted, or five minutes elapse.

Alerts Inhibited During Takeoff

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
EICAS advisory message TCAS OFF	Messages are inhibited	On ground	400 feet radio altitude
TCAS TA voice alerts	TCAS TAs		Approximately 500 feet radio altitude
All TCAS RAs	TCAS RAs are inhibited When RA selected on panel, TCAS switches automatically to TA only mode and TCAS message TA ONLY is displayed on ND		Approximately 1,000 feet radio altitude
TCAS DESCEND RAs	Alerts are inhibited		Approximately 1,100 feet radio altitude

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
Red ENG FAIL on PFD	Engines not producing commanded thrust and rate of thrust increase insufficient; same condition as EICAS messages ENG THRUST L, R	Engine start	65 knots airspeed
EICAS caution message ENG THRUST L, R	Messages are inhibited		Six knots before V1
STATUS cue	All EICAS status messages		30 minutes after lift-off.
All EICAS communication messages except: CABIN ALERT Hi-Lo Chime	Messages are inhibited		400 feet radio altitude or 20 seconds after lift-off, whichever occurs first, or on the ground and thrust on both engines reduced below takeoff thrust range

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
Master CAUTION lights Beeper If the Master CAUTION lights illuminate before reaching 80 knots airspeed, they continue to be illuminated when 80 knots airspeed is exceeded and cannot be extinguished until the inhibit ends. If new EICAS caution messages are displayed during the inhibit, the beeper will sound when the inhibit ends.	New EICAS caution messages displayed during inhibit	80 knots airspeed	400 feet radio altitude or 20 seconds after lift-off, whichever occurs first. If rejected takeoff initiated above 80 knots, inhibit continues until airspeed is less than 75 knots.
All EICAS advisory messages	Messages are inhibited		400 feet radio altitude or 20 seconds after lift-off, whichever occurs first, or if takeoff thrust not selected on both engines. If rejected takeoff initiated above 80 knots, inhibit continues until airspeed is less than 75 knots.
New PWS caution alerts	Messages are inhibited		400 feet radio altitude
New PWS warning alerts	Messages are inhibited	100 knots airspeed	50 feet radio altitude
New red ENG FAIL on PFD	EICAS caution message ENG THRUST L, R	Six knots before V1	Landing

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
Master WARNING lights Bell If the Master WARNING lights illuminate and fire bell sounds before reaching V1, they continue to be illuminated and sound when V1 is exceeded. If new FIRE messages are displayed during the inhibit, the bell will sound when the inhibit ends.	New EICAS warning messages FIRE displayed during inhibit.	V1 or rotation, whichever occurs first.	400 feet radio altitude or 25 seconds after inhibit began, whichever occurs first.
Master WARNING lights Siren If the Master WARNING lights illuminate and siren sounds before reaching V1, they continue to be illuminated and sound when V1 is exceeded If new EICAS warning messages are displayed during the inhibit, the siren will sound when the inhibit ends.	New EICAS warning messages displayed during inhibit, except FIRE		
EICAS warning messages CONFIG for takeoff configuration warnings	Messages are inhibited		Landing
Master WARNING lights Siren	EICAS warning message CONFIG GEAR for landing configuration warnings.	Gear unlock for retraction	825 feet radio altitude or 150 seconds after inhibit began, whichever occurs first.
All PWS alerts	Messages are inhibited	1,200 feet radio altitude	Approach

Alerts Inhibited During Landing

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
All PWS alerts	Alerts are inhibited	2,300 feet radio altitude	1,200 feet radio altitude
TCAS INCREASE DESCENT RAs		Approximately 1,500 feet radio altitude	Go-around at approximately 1,500 feet radio altitude
TCAS DESCEND RAs		Approximately 1,100 feet radio altitude	Go-around at approximately 1,100 feet radio altitude
All TCAS RAs	Alerts are inhibited When RA selected on panel, TCAS switches automatically to TA only mode and TCAS message TA ONLY is displayed on ND	Approximately 1,000 feet radio altitude	Go-around at approximately 1,000 feet radio altitude
All EICAS communication messages, except: CABIN ALERT	Messages are inhibited	800 feet radio altitude	75 knots airspeed
STATUS cue	All EICAS status messages		
TCAS voice alerts	TCAS TAs	Approximately 500 feet radio altitude	Go-around at approximately 500 feet radio altitude
New PWS caution alerts	Alerts are inhibited	400 feet radio altitude	80 knots airspeed
EICAS alert message WINDSHEAR SYS	Message is inhibited		
EICAS advisory message TCAS OFF			Go-around at 400 feet radio altitude

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
RAAS voice annunciations except: CAUTION SHORT RUNWAY, SHORT RUNWAY	Voice annunciations are inhibited	300 feet above field elevation	750 feet above field elevation on approach
RAAS voice annunciation CAUTION SHORT RUNWAY, SHORT RUNWAY			450 feet above field elevation on approach
RAAS amber message on ND SHORT RUNWAY			
Master CAUTION lights Beeper	All EICAS caution messages, except: AUTOPILOT AUTOTHROTTLE DISC NO AUTOLAND SPEEDBRAKE EXTENDED	LAND 2 or LAND 3 displayed on PFD, and 200 feet radio attitude	75 knots airspeed, or 40 seconds elapse, or 800 feet radio altitude
New PWS warning alerts	Alerts are inhibited	50 feet radio altitude	100 knots airspeed

EICAS Event Record

Pushing the EICAS EVENT RCD switch records currently displayed engine indications and additional EICAS maintenance information. Up to five events may be recorded by the first five pushes. The system also records out of limit parameters and related conditions automatically when a system parameter is exceeded.

Warning Systems**EICAS Messages****Chapter 15****Section 30****Warning Systems EICAS Alert Messages**

Message	Level	Aural	Message Logic
AIRSPPEED LOW	Caution	Beeper	Airspeed is below minimum maneuvering speed.
ALTITUDE ALERT	Caution	Beeper	Airplane has deviated from MCP selected altitude.
ALTITUDE CALLOUTS	Advisory		Altitude and minimums voice annunciations during approach are no longer provided.
CONFIG DOORS	Warning	Siren	A door is not closed, latched, and locked when either engine's thrust is in the takeoff range on the ground.
CONFIG FLAPS	Warning	Siren	Flaps or slats are not in a takeoff position when either engine's thrust is in the takeoff range on the ground.
CONFIG GEAR	Warning	Siren	Any landing gear is not down and locked when either thrust lever is closed below 800 feet radio altitude or when flaps are in a landing position.
CONFIG GEAR STEERING	Warning	Siren	Main gear steering is unlocked when either engine's thrust is in the takeoff range on the ground.
CONFIG PARKING BRAKE	Warning	Siren	Parking brake is set when either engine's thrust is in the takeoff range on the ground.
CONFIG RUDDER	Warning	Siren	Rudder trim is not centered when either engine's thrust is in the takeoff range on the ground.

[After PRR 63003]

CONFIG SPOILERS	Warning	Siren	Speedbrake lever is not DOWN when either engine's thrust is in the takeoff range on the ground; or, speedbrake lever extended beyond ARMED in flight, and climb thrust or greater set on either thrust lever.
-----------------	---------	-------	---

[\[Before PRR 63003\]](#)

CONFIG SPOILERS	Warning	Siren	Speedbrake lever not DOWN when either engine's thrust is in the takeoff range on the ground.
--------------------	---------	-------	--

CONFIG STABILIZER	Warning	Siren	Stabilizer is not within the greenband when either engine's thrust is in the takeoff range on the ground.
CONFIG WARNING SYS	Advisory		A fault is detected in the configuration warning system.
GND PROX SYS	Advisory		Ground proximity alerts are no longer provided.
OVERSPEED	Warning	Siren	Airspeed has exceeded Vmo/Mmo.
PILOT RESPONSE	Warning	Siren	After caution message PILOT RESPONSE displayed, FMC does not detect crew activity in monitored area within a specified time.
PILOT RESPONSE	Caution	Beeper	After advisory message PILOT RESPONSE displayed, FMC does not detect crew activity in monitored area within a specified time.
PILOT RESPONSE	Advisory		FMC does not detect crew activity in monitored area within a specific time.
RUNWAY OVRD	Advisory		Runway Override switch is in OVRD.
RUNWAY POS	Advisory		RAAS not operating because GPS position accuracy is inadequate.
RUNWAY SYS	Advisory		RAAS failed, or RAAS unavailable because airport is not in the RAAS database.
TAIL STRIKE	Caution	Beeper	A tail strike has been detected.
TCAS	Advisory		TCAS has failed.
TCAS OFF	Advisory		TCAS is in standby mode.
TCAS RA CAPTAIN, F/O	Advisory		TCAS cannot display RA guidance on the affected PFD.

TERR OVRD	Advisory		Ground proximity terrain override switch is in OVRD.
TERR POS	Advisory		Terrain position data has been lost.
WINDSHEAR SYS	Advisory		Windshear alerts may not be provided.

Intentionally
Blank